The New Zealand
# Journal of Agriculture.

VOL. 54. WELLINGTON, 20TH MAY, 1937. No. 5.

## THE FEEDING OF PIGS.

M. J. SCOTT, Superintendent of the Pig Industry, Department of Agriculture, Wellington.

### ORGANIZING THE FEED-SUPPLY.

AMONG those who inquire about the feeding of pigs, the man who is short of feed, either because it is not to be had or because it is too dear to buy, is met most frequently. The man who has abundance of feed, whatever its kind, is seldom inquiring. The man who has plenty of feed may have it by chance, but more usually his plenty is the result of his own planning. Organization and planning is not a very pleasant pastime: it is far more necessary with the feed-supply of pigs than it is with that of cattle and sheep, and for this reason pig-keeping is not popular.

Organization with pigs is important, because at least 80 per cent. of the value of a pig is the feed it has eaten, because pigs get very little of their feed from the paddocks—they are mostly hand-fed—because they are fed on relatively concentrated and therefore valuable food-stuffs, and because they have two peak-production periods each year, and so do not fit into the single yearly peak of natural growth in the way that cows, sheep, and other animals do. The questions of cost and distribution of the feed-supply require special consideration.

Where skim-milk is the chief summer feed, the question of value or cost is not important, but the one of distribution is very much so. Some source of winter-feed supply is essential if value is to be obtained from a costless milk-supply. It is easy to feed pigs on skim-milk for some one else's profit, if much feed is bought or if insufficient attention is given to a cheap winter-feed supply. Where grain is the chief source of feed-supply the question of distribution does not arise, since grain can be stored till it is wanted, but the question of cost is all-important. Both milk and grain are high-quality feed-supplies: each bears dilution with cheap low-quality feed, and in both cases profits are determined solely by the amounts of cheap feeds that are used. Organization and planning of a feed-supply is therefore of considerable importance.

## Cheap Feed the Basis of Profit.

The necessity of cheap feed is not peculiar to New Zealand, but it is the very essence of profit here, because of the relatively low prices of pig meats. Many farmers get from pigs returns as high as 60s. per cow. Some attribute their success to the fact that they produce weaners, others that they produce baconers, others to a thrifty strain of pigs, others to the care they exercise in looking after their pigs, and others to the skilful use of small quantities of grain. A consideration of the circumstances leads one to the conclusion that none of these things is the prime cause of success. They are merely incidentals, and the common factor of all successful pig-feeders is that they have used, along with their milk and grain, cheap, home-grown feed, roots, or pastures in such a quantity that about half the total feed used is grain and milk.

## Feed Quantities required.

To feed a sow for a year and produce two litters (fourteen pigs) to the weaner stage, feed equivalent to about 3,000 gallons of skim-milk or 1½ tons of grain in required. To feed the sow and litters to the pork stage (90 lb. carcass), 4 tons of grain or its equivalent is required, and to feed a sow and the litters to the bacon stage (140 lb. carcass), 6 tons of grain is required. When weaners are 14s. per head and pork and bacon 5d. per pound, the gross returns for feed used (milk alone, grain alone, or milk and grain) are about £6 12s. per short ton of grain, and about ¾d. per gallon of milk (on the basis of 500 gallons, 31s. per cow). This is a gross theoretical maximum that may be achieved with grain, since grain can be stored until it is required, but is certainly not attainable with milk because of its poor distribution throughout the pig-feeding year. If, now, half the feed-units are replaced by pasture or roots, the costs and returns are somewhat as follows: Using the case of porker-production as an example, 4,000 gallons milk (or 2 tons grain) plus 20 tons of roots give a gross return of 14 pigs × 90 lb. × 5d. per pound = £26 15s.; roots cost, say, 5s. per ton: total, £5. And so the 4,000 gallons of milk (2 tons grain) show a gross return of £21 15s.—*i.e.*, £10 17s. 6d. per ton for grain, or 1·3d. per gallon for skim-milk, or 54s. per cow: Some may consider it unprofitable to produce roots at 5s. per ton. Nevertheless the whole success of pig-production depends on roots at this cheap rate, and it is certain that if the root crop at 5s. per ton is itself unprofitable because of low yield or high production-costs, then roots cannot be used to enhance the profits. Others may object that roots are a dangerous or unsuitable pig-feed, and the answer to that objection is that many use them with success and satisfaction.

## Kinds of Cheap Feeds to grow.

Roots have been nominated in the above case as the most suitable feed, but no hard and fast rule can be laid down. The only guide as to which is the best source of cheap feed is the yield of feed-units that can be obtained and the cost of obtaining it. The following table gives feed-units per ton and yields per acre.

*Table I.—Comparative Values of Different Feedstuffs and Yields per Acre.*

| Crop. | Yield in Tons per Acre. | Pounds Feed-units per Ton. | Pounds Feed-units per Acre. |
|---|---|---|---|
| Parsnips | 40 | 240 | 9,600 |
| Carrots | 40 | 200 | 8,000 |
| Swedes | 45 | 160 | 7,200 |
| Cabbage | 30 | 200 | 6,000 |
| Chou moellier | 20 | 180 | 3,600 |
| Kale | 15 | 200 | 3,000 |
| Rape | 9 | 240 | 2,160 |
| Mangels | 60 | 150 | 9,000 |
| Artichokes | 12 | 400 | 4,800 |
| Potatoes | 12 | 400 | 4,800 |
| Stock melons | 60 | 130 | 7,800 |
| Pumpkins | 60 | 180 | 10,800 |
| Soft turnips | 30 | 100 | 3,000 |
| Grass | 18 | 260 | 4,680 |
| Lucerne, green | 16 | 200 | 3,200 |
| Lucerne hay | 5 | 650 | 3,250 |
| Silage | 12 | 270 | 3,240 |
| *Grains (short tons)*— | | | |
| Barley | 1 | 1,440 | 1,440 |
| Maize | 1½ | 1,640 | 2,420 |
| Wheat | 1 | 1,460 | 1,460 |
| Peas | 1 | 1,400 | 1,400 |
| Oats | 1 | 1,200 | 1,200 |
| Pollard | .. | 1,200 | .. |
| Bran | .. | 900 | .. |
| Meat-meal | .. | 1,800 | .. |
| Linseed-meal | .. | 1,600 | .. |

In the above table each crop has a yield in tons per acre set out beside it. These cannot be the relative yielding-capacities of these crops in any locality. They are included here for the purpose of calculating the amount of feed-units grown per acre at that yield. It is necessary to take both yield and quality into account in valuing a crop and then to look at the costs of growing that crop in comparison with other crops. In the past too many have grown crops because of convenience or prejudice. While convenience is of some importance, it can be overdone. Artichokes are often grown as a pig-feed because they call for very little expense, and little work in feeding them. A 6-ton crop of artichokes producing 2,400 feed-units per acre for just the cost of the rent, say, 30s. per acre, compares favourably with an 80-ton crop of mangels producing 12,000 feed-units if the mangels cost £8 per acre to produce. The middle course is, however, probably the most useful. Grow small areas of several different crops in place of a larger area of any particular one. Do not grow 2 tons of artichokes when your land could grow 100 tons of mangels per acre.

It has been stated that the ideal amount of these cheap feeds is about half the total feed used, and in quantity this amounts to 2½ tons for every cow milked, say, 1 acre of a good crop for 30 cows plus 10 tons for

every ton of grain bought. There is nothing to be gained by trying to use still greater amounts of the cheap feed, because the quality of the whole feed-supply is so reduced by using too much cheap feed that it is impossible to get pigs to thrive on it.

### How to use Cheap Feed.

In order to use this specialized cheap feed-supply it is probable that slight departures have to be made from the usual routine of pig-keeping. It is probably convenient to have the winter stores ready to fatten to baconers when the milk first comes in, and weaners from the spring litters ready to use the milk somewhere in November. For pigs that are not being fattened a small allowance of milk, not more than 1 gallon per day, along with as much other feed as they will eat seems to be the general practice. Where these cheap feeds (soft turnips, rape, lucerne, or grass) are likely to taint or discolour carcasses, they must be withdrawn during the last three weeks prior to slaughter. Where milk is not available during winter, meat-meal must be used along with roots, especially with younger pigs and sows.

### Amounts of Feed required per Day.

Much has been written about the amounts to be fed to pigs per feed or per day. On most places pigs are users of all the skim-milk, and provided they clean it up each day no one cares whether it is 20 per cent. too much or 10 per cent. too little. Pigs can grow at rates varying from nothing up to 3 lb. per day, and from this it follows that the amount of feed given can vary over a very wide range. All animals are most accommodating in this respect—they can over-eat for a few days and keep quite healthy; they can under-eat for many days and still look satisfactory. Eating 6 lb. of feed per day they may be bloated; eating 2 lb. they may be hungry.

It is possible to state how much feed is required daily only when the weight of the animal, the growth-rate per day, and the kind of feed are also stated. Expressed in feed equivalent in value to barley a young growing animal can eat a maximum of 6 per cent. of his weight each day; a 50 lb. pig can eat 3 lb.; on the other hand, an aged sow can live on a minimum of 1 per cent. of her live-weight—*i.e.*, a sow of 400 lb. weight can live on 4 lb. of feed per day. There is, however, a satisfactory growth-rate at which average pigs grow and keep healthy, and the feed consumed under these conditions amounts to about 4 per cent. of the pig's weight, slightly higher when young, slightly lower when old. The following table sets out the average age in weeks, weight in pounds, growth-rate in pounds per day, and feed consumption in pounds per pig per day. (Feed as pounds of barley-meatmeal mixture, or as gallons of skim-milk.)

*Table II.—Daily Rations for Pigs—Rapid Growth.*

| Age (Weeks). | Live-weight (Pounds). | Live-weight Increase per Day (Pounds). | Pounds of Feed daily for | | |
|---|---|---|---|---|---|
| | | | Maintenance. | Production. | Total. |
| 1 | 6·0 | 0·5 | Mother's milk sole feed-supply. | | |
| 2 | 9·5 | 0·5 | | | |
| 3 | 12·3 | 0·4 | | | |
| 4 | 15·8 | 0·5 | .. | .. | .. |
| 5 | 20·0 | 0·6 | 0·90 | 0·30 | 1·20 |
| 6 | 24·9 | 0·7 | 1·00 | 0·40 | 1·40 |
| 7 | 29·8 | 0·7 | 1·20 | 0·46 | 1·66 |
| 8 | 35·4 | 0·8 | 1·25 | 0·48 | 1·73 |
| 9 | 41·0 | 0·8 | 1·30 | 0·50 | 1·80 |
| 10 | 47·3 | 0·9 | 1·40 | 0·54 | 1·94 |
| 11 | 53·6 | 0·9 | 1·60 | 0·55 | 2·15 |
| 12 | 60·6 | 1·0 | 2·10 | 0·62 | 2·72 |
| 13 | 67·6 | 1·0 | 2·30 | 0·63 | 2·93 |
| 14 | 75·3 | 1·1 | 2·50 | 0·72 | 3·22 |
| 15 | 83·0 | 1·1 | 2·70 | 0·80 | 3·50 |
| 16 | 90·7 | 1·1 | 2·80 | 0·90 | 3·70 |
| 17 | 99·1 | 1·2 | 2·90 | 1·14 | 4·04 |
| 18 | 107·5 | 1·2 | 3·00 | 1·23 | 4·23 |
| 19 | 115·9 | 1·2 | 3·05 | 1·32 | 4·37 |
| 20 | 124·3 | 1·2 | 3·15 | 1·38 | 4·53 |
| 21 | 133·4 | 1·3 | 3·22 | 1·56 | 4·78 |
| 22 | 142·5 | 1·3 | 3·30 | 1·69 | 4·99 |
| 23 | 151·6 | 1·3 | 3·39 | 1·79 | 5·18 |
| 24 | 160·7 | 1·3 | 3·44 | 1·87 | 5·31 |
| 25 | 170·5 | 1·4 | 3·50 | 2·12 | 5·62 |
| 26 | 180·3 | 1·4 | 3·58 | 2·27 | 5·85 |
| 27 | 190·1 | 1·4 | 3·64 | 2·37 | 6·01 |
| 28 | 199·9 | 1·4 | 3·70 | 2·42 | 6·12 |

These amounts have been calculated from first principles as laid down in Wood's Animal Nutrition, p. 163. The calculated amounts agree closely with those used in the most efficient feeding trials where healthy pigs have been fed in suitable sties and under suitable weather conditions.

In general it is most profitable to feed pigs in such a manner that they will grow as fast as they can. It has been found, however, that where pigs fatten and grow at the same time their carcass tends to be short and to carry too much back fat. Consequently one has to strike a happy medium between efficient feed-conversion and suitable carcass-quality. Pigs that grow at the rate of about 1⅓ lb. per day over the last stages of bacon-weights are usually not too fat on the back, and their efficiency as converters of feed is satisfactory.

## Feeding with Limited Quantities of Skim-milk.

The rates of growth and the amounts of feed set out in the last table are just about the maxima that average pigs are capable of. There are times when the feed-supply is limited and the growth-rate correspondingly small. It often happens that the growth-rate is so slow that interest in the pigs is lost and they become neglected. That's the dangerous time, everything seems to go wrong.

In the following table there are set out the rates of growth associated with a long store period, ½ lb. per day from fourteen weeks to twenty-eight weeks, about ¾ lb. per day for a further three months, until a weight of 170 lb. is attained, and then about 30 lb. in twenty days of finishing off.

*Table III.—Daily Rations for Pigs—Slow Growth.*

| Age (Weeks). | Live-weight (Pounds). | Live-weight Increase (per Day). | Pounds of Feed daily for | | |
|---|---|---|---|---|---|
| | | | Maintenance. | Production. | Total. |
| 1 | 6·0 | 0·5 | Mother's milk only. | | |
| 2 | 9·5 | 0·5 | | | |
| 3 | 12·3 | 0·4 | | | |
| 4 | 15·8 | 0·5 | .. | .. | .. |
| 5 | 20·0 | 0·6 | 0·90 | 0·30 | 1·20 |
| 6 | 24·9 | 0·7 | 1·00 | 0·40 | 1·40 |
| 7 | 29·8 | 0·7 | 1·20 | 0·46 | 1·66 |
| 8 | 35·4 | 0·8 | 1·25 | 0·48 | 1·73 |
| 9 | 40·3 | 0·7 | 1·28 | 0·42 | 1·70 |
| 10 | 44·5 | 0·6 | 1·35 | 0·36 | 1·71 |
| 11 | 48·7 | 0·6 | 1·45 | 0·36 | 1·81 |
| 12 | 52·9 | 0·6 | 1·56 | 0·36 | 1·92 |
| 13 | 57·1 | 0·6 | 1·80 | 0·36 | 2·16 |
| 14 | 61·3 | 0·6 | 2·10 | 0·36 | 2·46 |
| 15 | 64·8 | 0·5 | 2·10 | 0·34 | 2·44 |
| 16 | 68·3 | 0·5 | 2·30 | 0·35 | 2·65 |
| 17 | 71·8 | 0·5 | 2·39 | 0·35 | 2·74 |
| 18 | 75·3 | 0·5 | 2·48 | 0·35 | 2·83 |
| 19 | 78·8 | 0·5 | 2·57 | 0·35 | 2·92 |
| 20 | 82·3 | 0·5 | 2·67 | 0·35 | 3·02 |
| 21 | 85·8 | 0·5 | 2·75 | 0·40 | 3·15 |
| 22 | 89·3 | 0·5 | 2·79 | 0·40 | 3·19 |
| 23 | 92·8 | 0·5 | 2·82 | 0·45 | 3·27 |
| 24 | 96·3 | 0·5 | 2·89 | 0·45 | 3·34 |
| 25 | 99·8 | 0·5 | 2·96 | 0·48 | 3·44 |
| 26 | 103·3 | 0·5 | 2·98 | 0·50 | 3·48 |
| 27 | 106·8 | 0·5 | 3·00 | 8·50 | 3·50 |
| 28 | 110·3 | 0·5 | 3·02 | 0·55 | 3·57 |
| 29 | 115·0 | 0·7 | 3·05 | 0·77 | 3·82 |
| 30 | 120·0 | 0·7 | 3·10 | 0·77 | 3·87 |
| 31 | 125·0 | 0·7 | 3·15 | 0·80 | 3·95 |
| 32 | 130·0 | 0·7 | 3·18 | 0·82 | 4·00 |
| 33 | 135·0 | 0·7 | 3·22 | 0·84 | 4·06 |
| 34 | 140·0 | 0·7 | 3·28 | 0·88 | 4·16 |
| 35 | 145·0 | 0·7 | 3·30 | 0·94 | 4·24 |
| 36 | 150·0 | 0·7 | 3·36 | 0·95 | 4·31 |
| 37 | 155·0 | 0·7 | 3·40 | 0·96 | 4·36 |
| 38 | 160·0 | 0·7 | 3·44 | 0·98 | 4·42 |
| 39 | 165·0 | 0·7 | 3·47 | 1·00 | 4·47 |
| 40 | 170·0 | 0·7 | 3·50 | 1·02 | 4·52 |
| 41 | 177·0 | 1·0 | 3·55 | 1·65 | 5·20 |
| 42 | 187·0 | 1·5 | 3·60 | 2·47 | 6·07 |
| 43 | 200·0 | 1·8 | 3·70 | 3·15 | 6·85 |

This rate of growth can be obtained by using the pounds of grain or gallons of milk stated from weaning till fourteen weeks old, gradually changing then to ½ lb. of meat-meal or 1 gallon of milk plus all the cheap feed the pigs will eat—*e.g.*, grass, roots, potatoes, artichokes, marrows, &c.

When the pigs are 70 lb. alive they will have to eat ½ lb. of meat-meal and 17 lb. of roots per day in order to get 2¾ lb. of feed. At 110 lb. alive they will want ½ lb. of meat-meal and 24 lb. of roots. At 170 lb., ½ lb. meat-meal and 32 lb. of roots. During the last three weeks the use of roots is discontinued, and the pigs eat from 5¼ lb. up to more than 6¾ lb. of grain or gallons of milk per day.

### Economy of Feed-conversion.

Where the pigs grow rapidly the total feed-consumption is about 580 lb. per pig. It is all high-quality feed. Where the pigs grow slowly the total feed-consumption is about 865 lb. per pig. Of this, only 325 lb. is high-quality feed. The remaining 540 lb. is obtained from, say, 2 tons of mangels. All sorts of further calculations can be done by those who have followed so far, and the results all point to the advantages of using these cheap feeds.

At finishing, these pigs are about forty-three weeks old, and, if this takes place in the flush of the milk season, in, say, November and December, the pigs should have been farrowed in January and February. These fattening baconers should just be finished when the next litter is just out of its babyhood, and it could be taken rapidly to bacon at about six to seven months old.

### Balanced Feeds.

In every country of the world the first approach that the scientist makes to the question of feeding is by way of the composition of the feedstuffs. The amounts of protein, fat, and carbohydrate determine accurately the value of a feed, and a knowledge of them usually accounts for the observed properties of the feed. The man who uses the feed, however, can make little use of the analysis, nor can he take any advantage of the advice so frequently offered that he must use balanced feeds. Not only has the animal a tolerance for a very wide range of quantities, it has an even greater one for a range of qualities. After a short time it can adjust itself to four or even six times the amount of protein that is ideal, and can get along with about half the quantity it should require. Similarly, with minerals, it can live and be healthy with just the minerals found in grain or it can consume added minerals at the rate of ounces per week. This tolerance is most remarkable while the pig is "idling" and while it has a few reserves stored away in its body. As soon as these reserves become depleted or when the pig is fed, liberally enough to grow, then trouble arises. This takes the form of any of the common ailments from lameness and rickets to constipation, worm-infection, to pleurisy. Unsuitable feed that lowers the tone of the animal system is the opening through which most of the ailments of pigs find entry. Those whose pigs grow satisfactorily but still are subject to certain ailments may dissent from the viewpoint stated above. It is quite possible to get rapid growth on unsuitable feed, but it need not be healthy growth. With unsuitable feeds the more rapid the growth the more unhealthy the animal is—a fact that is made use of in the production of experimental rickets. Even although it is "growth for feed used" that makes a feed-supply valuable, growth and good health are a better combination than

growth and ill health. The signs of health that are unmistakable are a sleek coat, a shining skin, a bright eye, energetic action, and normal excreta. A feed-supply that leaves pigs wanting in any of these, in spite of the fact that the pigs are growing rapidly, is unbalanced, and would be improved by the addition of the missing ingredient.

### The Missing Ingredient.

Most people can tell at a glance if their pigs are in normal health, but because of the interplay of many factors such as age, rate of growth, amount of sunlight, presence or absence of parasites, and all the variables that influence a pig's health it is often difficult to recommend with any measure of assurance treatment that will improve things. Although the value of minerals, condiments, and vitamins is widely recognized, it is most remarkable how many healthy pigs there are in the country that get no added minerals or condiments, and live, sometimes on skim-milk, sometimes on butter-milk, sometimes on offal, and sometimes on a wide variety of home-grown feeds plus milk. The common thread that runs all through these different places is the care of the owner. He feeds regularly, he feeds just as much as the pigs clean up. His pigs are always looking for more, but never really hungry. He is a careful observer. Any pigs that require attention get it promptly. He is careful to have just the right number of pigs that will use his feed-supply at every time of the year, and generally he pays attention to all the details that require attention. As a result one can say with a good deal of conviction, and with no desire to be clever or offensive, that the best supplement than can be used with any feed-supply, no matter what its origin, is understanding and care on the part of the owner. It is not every one's good fortune that he can take care; or, put otherwise, things go wrong with some in spite of the best of care. In such cases it becomes necessary to find something than can be added to the ration in order to keep pigs healthy with limited care.

### Minerals or Vitamins or ?

One of the most striking happenings associated with pig-feeding is the wonderfully sleek appearance of pigs that are being fed on lucerne. Whatever their age or state, after weaning, pigs that receive lucerne, green or as chaffed hay, are always sleek and healthy, provided, of course, that lucerne is not their sole feed. Whether its value lies in the minerals contained in it, or in the vitamins, or the protein value, we will never know, because of the difficulty of separating these things, but the fact remains that lucerne puts a shine on the coat not excelled by any other class of feedstuff. Next to lucerne, ordinary green pasture, provided it is young, keeps pigs quite healthy, and although not so universally excellent as lucerne nevertheless it is quite valuable. Next, the oil-bearing feeds such as linseed cake, oats, and meat-meal fed in small amounts make pigs healthy-looking, and here again it is impossible to fasten with any assurance on the ingredient that is most useful. Pigs fed on offal—boiled meat scrap—are always remarkably healthy, and one is almost forced to the conclusion that animal fat is most beneficial. Finally there are the well-known benefits that so many

have obtained from using minerals such as wood ashes, charcoal, slack coal, licks of various kinds containing salt or sulphur or iron or iodine or lime or phosphates. It seems impossible to make any authoritative statement on the question of minerals. The question was investigated by Sheehy in Northern Ireland some time ago, and over a period of five years after trying every kind of mineral-mixture he found that salt and limestone, 1 part to 4 parts, used at the rate of 3 per cent. of the dry-weight of feed was the most useful mineral. A pig of 100 lb. weight, eating 4 lb. of feed or its equivalent, would want daily about 1½ oz. of minerals. A useful way to feed minerals is to have the supply handy, and with a known measure, such as a baking-soda or other tin, put the calculated amount in the trough daily. It sounds very complicated, but it can be done quite easily if it is worth while.

### Attention to Detail more important than Anything else.

From what has been said it is apparent that in spite of the supposed advisability of knowing how much a pig should receive per day and how much protein, fat, carbohydrate, and minerals there is in his ration it is seldom that the good results obtained by a feeder can be ascribed to this knowledge. More usually success is associated with attention to some or all of the following rules:—

(1) Feed regularly as to time and amount.

(2) Feed just as much as the pigs will clean up.

(3) Do not leave stale food in troughs. Movable troughs can be profitably turned over; fixed ones could profitably have a hinged lid that keeps the trough clean.

(4) If pigs fail to thrive after attention has been given to the above rules, then the quality of the feed-supply is at fault or the pigs are unhealthy. It always pays to correct the trouble, and the improvement of the feed-supply is either a matter of adding green grass to the ration or ½ lb. of any grain or ¼ lb. to ½ lb. of meat-meal; or perhaps 1 oz. of lime and salt mixture. Experience usually decides which of these gives results.

### Quality usually good.

It is rarely that the feed-supply itself is of such a quality that it can be blamed for poor pigs. On any place where pigs are kept there may be a dozen healthy pigs for every sick one. It is a fair assumption that the sick one is the result of some chill or setback such as human beings experience from time to time, and that the dozen healthy ones are a striking advertisement for the excellent quality of the feed-supply. This is generally correct for those months of the year when skim-milk is the chief source of feed-supply. When skim-milk is in short supply it often happens that most of the pigs fade visibly, either because they have too little feed or else because the quality of their feed is below standard. The feeds in use are usually home-grown, varying from grass through any kind of fodder crop to roots of all descriptions, plus at times a little grain. There is one addition that can be made to every feed-supply, skim-milk included, that will always bring feed-quality up to a standard that enables pigs to thrive—*i.e.*, meat-meal.

## Use of Meat-meal.

Meat-meal added at the rate of ¼ lb. to ½ lb. per pig per day improves every known feed for pigs in proportion to its unsuitability. Added to raw potatoes or roots of any description, feeds on which young pigs go back in condition, even to the stage of dying, and on which grown pigs just "hold their own," meat-meal improves the feeding-value from about 3s. per ton up to 30s. per ton, after paying for the meat-meal used.

Grass fed to pigs returned about 12s. per acre per month without meat-meal, with meat-meal the value of grass was 40s. per acre per month, after paying for the meat-meal. These are striking improvements, so striking that they almost have to be seen first before they can be believed. One does not appreciate the value of meat-meal unless the results of it have been seen, and there is certainly no feed used in small amounts that does give such striking results, especially with feeds that are not by themselves pig-feeds. With milk or grain the benefits from using meat-meal are still noticeable, but not in such a definite way. As a general rule, meat-meal at the rate of ½ lb. per day or skim-milk at the rate of 1 gallon per day should be used as a foundation feed-supply for all pigs after weaning. From weaning until pigs are 70 lb. live-weight—*i.e.*, at twelve to fourteen weeks old—they are still babies, and should receive as a minimum 2 gallons of milk per day, or ½ lb. of meat-meal and 1½ lb. of grain. In addition they may be fed further milk or grain, as much as they will eat, or else they should be allowed access to roots or pasture to "pick up" as much as they want. This 2 gallons or 2 lb. of feed supplies all their wants till they are about 50 lb. weight, but only enough for limited growth after that weight. Unless it is supplemented with other feed, growth will be slow after 50 lb. is reached. If the pigs are being taken on to porkers, it probably pays to give them as much skim-milk as they will consume, especially if there is abundance of it. If the supply is limited, skim-milk can be gradually reduced to 1 gallon per day after twelve to fourteen weeks, plus as much grass, roots, &c., as the pigs can consume. Where grain is the main feed-supply, it is wise to reduce the amount and let the pigs grow slowly on light rations from 70 lb. to about 110 lb. over a period of about eight to ten weeks. Three weeks' finishing should make them prime at about 140 lb. alive if their treatment has not been too hard.

If bacon is being produced, the slow-growth period can go on for eight months, till the pigs are 170 lb. live-weight. Three weeks' "topping off" on full rations makes them into baconers of 200 lb. live-weight.

---

A noteworthy feature is the trend of public opinion in the direction of a tuberculin-tested milk-supply. This is indicated by the requests of certain local authorities to have all cows supplying milk for human consumption inside their areas subjected to the tuberculin test. There can be little doubt that this requirement will extend, and it would appear that its application generally throughout the Dominion as a compulsory measure is not far off. In my report of last year I advocated its adoption, and I am convinced that it must be regarded as a sound forward movement in the interests of public health.—*Annual Report, Director of the Live-stock Division.*

# APPLICATION OF ORCHARD SPRAYS.

## III. SPRAY NOZZLES (*continued*).

G. G. TAYLOR, Plant Diseases Division, Plant Research Bureau, Palmerston North.

### VOLUME DELIVERY.

THE rapidity with which a complete coverage of spray can be obtained is dependent, to a large extent, on the rate at which spray is discharged from the nozzle (or combination of nozzles) in use. Volume delivery is a factor indicating the performance of any nozzle in this respect, the volume of water delivered in one minute being the standard used for comparing different nozzles. In practice, volume delivery is affected by the nature of the spray-mixture, but for comparative purposes such differences are not of practical significance.

#### EXPERIMENTAL METHOD.

The nozzles were directed into a wooden barrel for one minute. The water thus collected was weighed and the volume calculated by allowing 10 lb. for 1 gallon. Repeated measurements by this method showed that the maximum error was 0·05 gallons. The mean of two measurements was taken for each nozzle.

In collecting the water it was found necessary to keep the nozzle clear of the surface of the water, and to provide a loosely fitting lid to the barrel to prevent loss by splashing.

Pressure was varied by adjustment at the pump and measured by a pressure-gauge inserted a few inches behind the nozzle. Constructional differences in the various nozzle parts were identical with those previously used for testing distribution and fineness of spray droplets (see this *Journal*, Vol. 53, p. 68).

#### RESULTS.

*Pressure.*—Volume delivery showed an increase as the pressure was increased from 50 lb. to 300 lb. The rate of increase tended to diminish as the higher pressures were reached (Fig. 23). Increase in volume delivery with increasing pressure was greatest where disks having the largest apertures were used (Fig. 23).

*Disk Apertures.*—Increase in the diameter of disk apertures from $\frac{3}{64}$ in. to $\frac{4}{64}$ in., $\frac{5}{64}$ in., $\frac{6}{64}$ in., $\frac{7}{64}$ in., and $\frac{8}{64}$ in. increased volume delivery. The rate of increase varied according to the structure of the whorl-plate in use, being highest where the diameter or number of the openings in the whorl-plate was greatest or the angle of the openings was least (Fig. 24).

*Thickness of Disk.*—Increase in the thickness of disks from $\frac{2}{64}$ in. to $\frac{4}{64}$ in. caused a small reduction in volume delivery. Further increase in thickness to $\frac{6}{64}$ in. had no measurable effect.

*Depth and Shape of Whorl-chamber.*—Volume delivery showed a slight increase when the depth of the whorl-chamber was increased from 0·08 in. to 0·24 in.

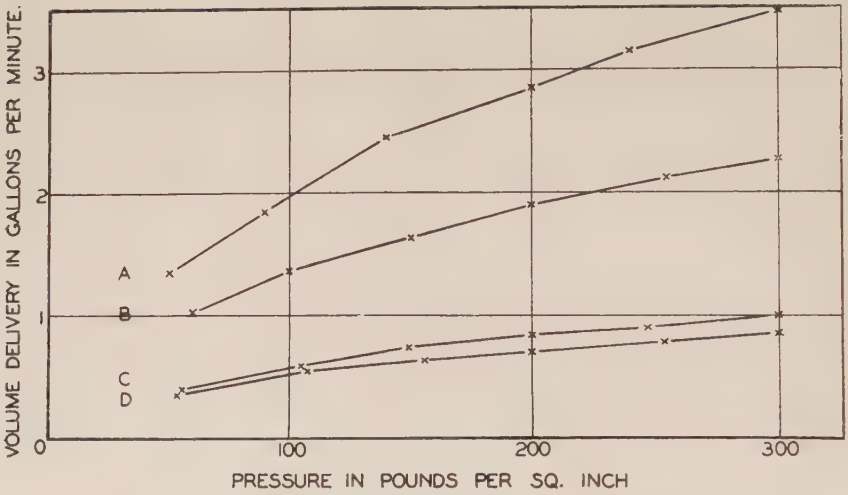



FIG. 23. EFFECT OF INCREASE IN PRESSURE ON VOLUME DELIVERY.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate, six openings, $\frac{8}{64}$ in. diameter ; angle, 22·5° ; disk aperture, $\frac{8}{64}$ in. diameter.

Curve B : Whorl-plate, six openings, $\frac{8}{64}$ in. diameter ; angle, 22·5° ; disk aperture, $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate, six openings, $\frac{4}{64}$ in. diameter ; angle, 22·5° ; disk aperture, $\frac{8}{64}$ in. diameter.

Curve D : Whorl-plate, six openings, $\frac{4}{64}$ in. diameter ; angle, 22·5°, disk aperture, $\frac{4}{64}$ in. diameter.

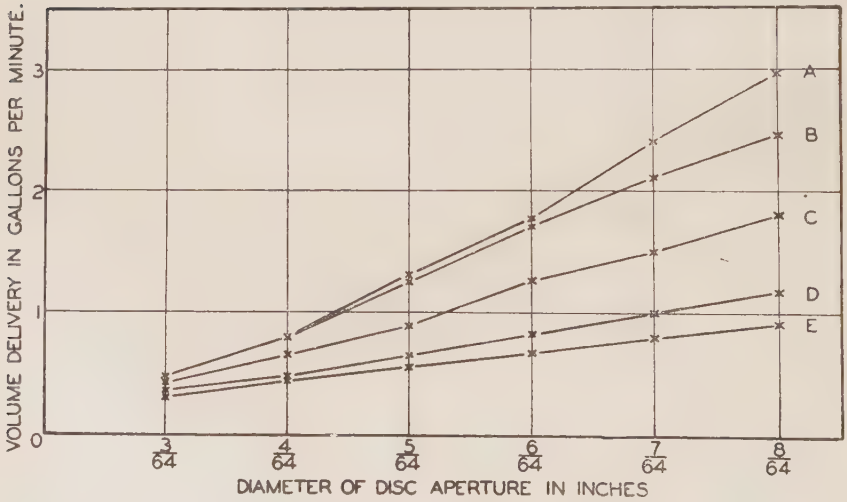



FIG. 24. EFFECT OF INCREASE IN DIAMETER OF DISK APERTURE ON VOLUME DELIVERY AT A NOZZLE PRESSURE OF 200 LB. PER SQUARE INCH.

The different curves show the effects produced when using whorl-plates of varying construction, as follows :—

Curve A : Whorl-plate, four openings, $\frac{12}{64}$ in. diameter ; angle, 45°.

Curve B : Whorl-plate, four openings, $\frac{8}{64}$ in. diameter ; angle, 22·5°.

Curve C : Whorl-plate, four openings, $\frac{8}{64}$ in. diameter ; angle, 67·5°.

Curve D : Whorl-plate, two openings, $\frac{8}{64}$ in. diameter ; angle, 67·5°.

Curve E : Whorl-plate, four openings, $\frac{4}{64}$ in. diameter ; angle, 45°.

The introduction of a $\frac{1}{4}$ in. diameter pin projecting approximately 0·04 in. from the centre of the whorl-plate into the whorl-chamber had no measurable effect on volume delivery. With the pin projecting 0·08 in. volume delivery was slightly reduced.

*Diameter of Whorl-plate Openings.*—Increasing the diameter of the whorl-plate openings from $\frac{4}{64}$ in. to $\frac{8}{64}$ in. and $\frac{12}{64}$ in. increased volume delivery. The rate of increase was highest where disks with apertures of the greatest diameter were used (Fig. 25).

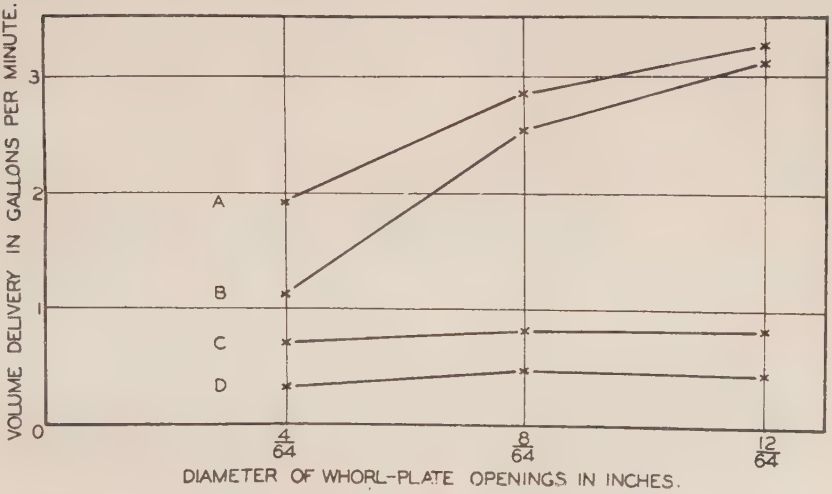



FIG. 25. EFFECT OF INCREASE IN DIAMETER OF WHORL-PLATE OPENINGS ON VOLUME DELIVERY AT A NOZZLE PRESSURE OF 200 LB. PER SQUARE INCH.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate, six openings ; angle, 22·5° ; disk aperture, $\frac{5}{64}$ in. diameter.

Curve B : Whorl-plate, six openings ; angle, 22·5° ; disk aperture, $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate, six openings ; angle, 45° ; disk aperture, $\frac{5}{64}$ in. diameter.

Curve D : Whorl-plate, six openings ; angle, 45° ; disk aperture, $\frac{3}{64}$ in. diameter.

*Angle of Whorl-plate Openings.*—In most instances volume delivery decreased as the angle of the whorl-plate openings was increased from 22·5° to 45° and 67·5° (Fig. 26). Where whorl-plates with openings $\frac{12}{64}$ in. in diameter were used, increase in the angle from 45° to 67·5° *increased* volume delivery (Fig. 26). This latter effect appeared to be due to the fact that with whorl-plate openings $\frac{12}{64}$ in. in diameter, increase in the angle of the openings from 45° to 67·5° increased the space available for direct flow of spray (Fig. 27), thus resulting in a reversal of the normal tendency for increase in the angle of the whorl-plate openings to *decrease* volume delivery.

The rate at which volume delivery decreased with increase in the angle of the whorl-plate openings was greatest where disks with the largest diameter openings were used (Fig. 26).

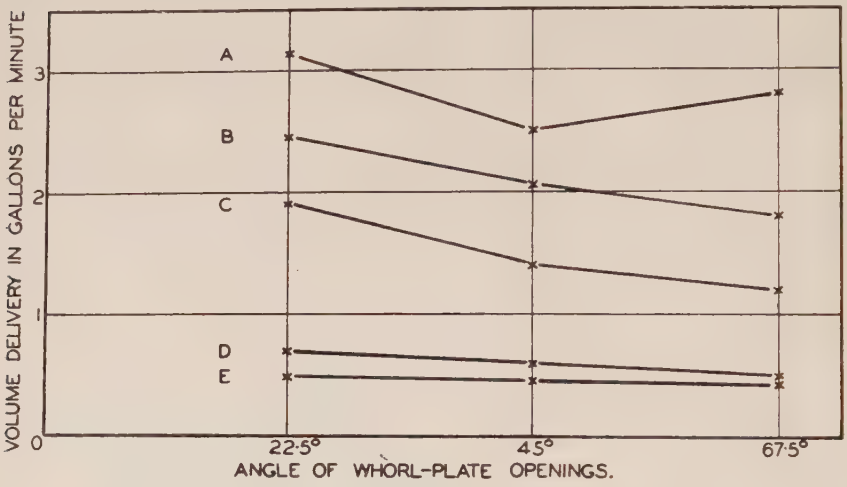



FIG. 26. EFFECT OF INCREASE IN THE ANGLE OF WHORL-PLATE OPENINGS ON VOLUME DELIVERY AT A NOZZLE PRESSURE OF 200 LB. PER SQUARE INCH.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate, four openings, diameter, $\frac{12}{64}$ in. ; disk aperture, $\frac{8}{64}$ in. diameter.
Curve B : Whorl-plate, four openings, diameter, $\frac{8}{64}$ in. ; disk aperture, $\frac{8}{64}$ in. diameter.
Curve C : Whorl-plate, four openings, diameter, $\frac{8}{64}$ in. ; disk aperture, $\frac{3}{64}$ in. diameter.
Curve D : Whorl-plate, two openings, diameter, $\frac{8}{64}$ in. ; disk aperture, $\frac{8}{64}$ in. diameter.
Curve E : Whorl-plate, two openings, diameter, $\frac{8}{64}$ in. ; disk aperture, $\frac{4}{64}$ in. diameter.

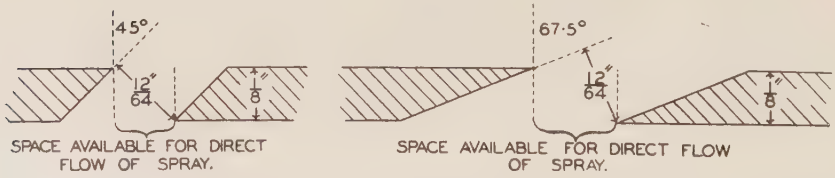



FIG. 27. SECTIONS OF WHORL-PLATE SHOWING INCREASE IN THE AVAILABLE SPACE FOR DIRECT FLOW OF SPRAY WHEN THE ANGLE OF OPENINGS OF $\frac{12}{64}$ IN. DIAMETER IS INCREASED FROM 45° TO 67·5°.

*Number of Whorl-plate Openings.*—Increase in the number of whorl-plate openings from two to four and six increased volume delivery. The rate of increase was greatest where disks with apertures of the largest diameter were used (Fig. 28).

*Strainer.*—The use of a strainer caused a slight decrease in volume delivery.

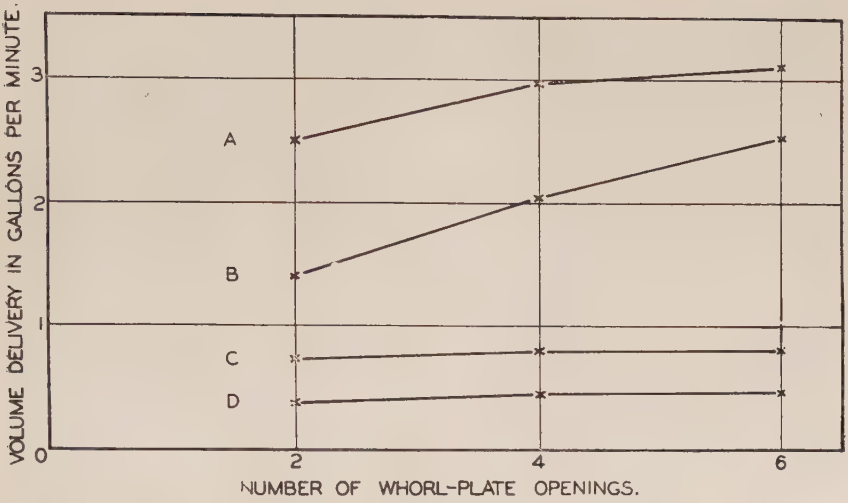



FIG. 28. EFFECT OF INCREASE IN THE NUMBER OF WHORL-PLATE OPENINGS ON VOLUME DELIVERY AT A NOZZLE PRESSURE OF 200 LB. PER SQUARE INCH.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate openings, $\frac{1}{64}$ in. diameter ; angle, 45° ; disk aperture, $\frac{8}{64}$ in. diameter.
Curve B : Whorl-plate openings, $\frac{1}{64}$ in. diameter ; angle, 45° ; disk aperture, $\frac{4}{64}$ in. diameter.
Curve C : Whorl-plate openings, $\frac{5}{64}$ in. diameter ; angle, 45° ; disk aperture, $\frac{8}{64}$ in. diameter.
Curve D : Whorl-plate openings, $\frac{5}{64}$ in. diameter ; angle, 45° ; disk aperture, $\frac{3}{64}$ in. diameter.

## Nozzle-construction in relation to Orchard Practices.

### DISCUSSION.

It is apparent that with variation in nozzle-construction differences can be obtained in the angle of the spray-cone, size of spray droplets, depth of penetration, and volume delivery. The most significant factors affecting the performance of the nozzle appear to be nozzle pressure, diameter of disk aperture, and the diameter, number, and angle of the openings in the whorl-plate. The effects of these are summarized below :—

| Increase in | Effects on | | | |
|---|---|---|---|---|
| | Size of Droplets. | Angle of Cone. | Depth of Penetration. | Volume Delivery. |
| Pressure .. | Considerably decreased | Increased at first then slightly decreased | Increased .. | Increased. |
| Diameter of disk aperture | Slightly increased | Considerably increased | Increased .. | Considerably increased. |
| Diameter of whorl-plate openings | Increased .. | Considerably decreased | Considerably increased | Considerably increased. |
| Number of whorl-plate openings | Slightly increased | Decreased .. | Increased .. | Increased. |
| Angle of whorl-plate openings | Slightly decreased | Increased .. | Decreased .. | Decreased. |

It has been shown that variation in nozzle pressure and in the construction of the different nozzle parts does not have constant effects owing to the relationship which exists between the several factors involved. For example, increase in volume delivery with increase in the diameter of the disk aperture may be great or small according to the construction of the whorl-plate. Variation in any one factor may improve nozzle performance in certain respects but be detrimental in others. For example, increased penetration may be obtained by whorl-plate adjustment, but at the same time the angle of the spray cone is reduced and the size of spray droplets increased. Thus it will be seen that before the exact performance of any nozzle can be determined, a complicated set of inter-related factors must be considered. Under practical conditions, however, it appears that nozzle pressure is of greatest significance in influencing the size of spray droplets, disk aperture in determining volume delivery and the angle of the spray cone, and whorl-plate construction—*i.e.*, diameter, angle, and number of openings—in varying the depth of penetration.

The general effects as summarized in the above table are substantially the same as those recorded by other workers (see this *Journal*, Vol. 53, p. 68, Table I) save that in the present investigations increase in the diameter of the disk aperture was found to cause a small increase in the size of spray droplets.

Alterations in the depth of the whorl-chamber and in the thickness of the disk were found to have effects similar to those recorded by other workers. Their effects, however, do not appear to be of sufficient magnitude to be of practical significance. The use of a strainer does not materially affect the performance of the nozzle.

## TYPES OF NOZZLE AVAILABLE.

The nozzles used in orchard practice are all based on the "cyclone" principle, but vary considerably in the details of construction. Two main types are involved—(*a*) fixed nozzles in which adjustment can only be made between intervals of spraying, and (*b*) spray-guns in which adjustment can be made while spraying is in progress.

Fixed nozzles are used singly or in groups of two or more on light-metal tubes of from 3 ft. 6 in. to 7 ft. in length, the whole unit usually being termed a "spray-rod." Frequently the only adjustment possible is by replacement of the disks. This allows for considerable variation in the diameter of the spray cone and in volume delivery, but not for sufficient adjustment in depth of penetration. In improved types provision is made either for replacement of the whorl-plate or for alteration in the size and angle of the whorl-plate openings, thus allowing for greater variation in the depth of penetration. The nozzles used with spray-rods are usually set at an angle in order to assist coverage of inaccessible portions of the trees such as the under surface of leaves, &c.

Spray-guns are about 20 in. in length and each consist of a tube of $\frac{3}{4}$ in. to 1 in. diameter with the nozzle at one end and a handle at the other, the latter being connected with the nozzle

by a rod passing through the tube. A pressure-tight gland is used where the rod leaves the tube. By twisting the handle, adjustment of the nozzle can be effected and the depth of penetration varied without interruption in spraying. In one type of gun the size of the whorl-plate openings is adjusted by means of a revolving plate, and in another the size of a central opening in the whorl-plate is varied by means of a retractable plunger. Similar methods to these, in which variation in the total extent of the whorl-plate openings is the principle involved, are adopted for most guns. With the short guns usually employed, angle nozzles cannot be conveniently used. It is possible, however, to obtain guns of up to 6 ft. in length, and with these angle nozzles can be used with advantage.

The principal advantage of the spray-gun lies in the readiness with which the depth of penetration can be varied. There is a tendency, however, to ignore the size of the trees or portion of the tree being sprayed and to "set" the gun to give a narrow cone of coarse droplets of spray having maximum penetration. This simplifies spraying, but increases the likelihood of missing portions of the trees and often results in wastage of spray. With careful usage equally good results can be obtained with spray-guns as with spray-rods, but under average orchard conditions greater efficiency is likely to be obtained with the latter.

## Recommendations.

The practical significance of volume delivery, size of spray droplets, &c., on spray coverage and in disease-control will be dealt with in subsequent papers. In the meantime the following tentative suggestions are made as regards nozzle-type:—

*Spray-rods.*—Suitable lengths vary from 4 ft. 6 in. to 6 ft., shorter rods losing the advantage of proximity to the higher parts of the trees, &c., and longer rods being too cumbersome to handle. Single nozzles are frequently employed, but double nozzles used on a Y or T piece appear to be more efficient owing to the greater width of the combined spray cones and the better distribution of spray droplets.

For the majority of New Zealand orchard trees double nozzles similar to the type illustrated in Fig. 2 (see this *Journal*, Vol. 53, p. 68) are suitable provided dimensions are as follows:—

*Whorl-plates:* $\frac{1}{8}$ in. thick and $1\frac{3}{16}$ in. diameter, with six openings of $\frac{1}{8}$ in. diameter centred on a circle $\frac{5}{8}$ in. diameter, and drilled at an angle of 45°.

*Whorl-chambers:* Approximately $\frac{1}{8}$ in. deep.

*Disks:* $1\frac{5}{16}$ in. diameter and approximately $\frac{3}{64}$ in. thick with the diameter of the apertures $\frac{5}{64}$ in. for summer use and from $\frac{4}{64}$ in. for winter use.

Increased penetration for large trees may be obtained by reducing the angle of the whorl-plate openings to 22·5°. If the increased penetration thus obtained is still insufficient, it may be necessary to use a single nozzle with six openings of $\frac{10}{64}$ in. diameter set at an angle of 22·5° and to increase the diameter of the disk aperture up to $\frac{8}{64}$ in. Nozzle pressure should be 250 lb. to 300 lb.

Many of the nozzles used with spray-rods vary from the types described above in number and construction. These give efficient service provided (*a*) that sufficient penetration is obtained, (*b*) that the width of the combined cones of spray is sufficient to assure that portions of the trees are not left unsprayed, and (*c*) that the volume delivery is such that maximum coverage can be obtained in minimum time. Volume deliveries of 3 gallons to 3·5 gallons per minute are sufficient for summer spraying of most trees, and 2·25 gallons to 2·75 gallons for winter spraying. For small trees volume delivery may be reduced slightly, and where the trees are large it may be increased to 4 gallons to 4·5 gallons per minute with advantage.

*Spray-guns.* — The most desirable types of spray-guns are those in which a fairly rapid and continuous change can be effected from a wide angle to a narrow angle cone of spray. Certain guns are undesirable in that there is a rapid change from a wide to a narrow cone at one point in the adjustment, making it difficult to obtain accurately any intermediate type of spray cone.

Volume deliveries of different guns vary so that the required disk-size should be found by trial. To this end the amount of spray delivered in one minute should be collected and measured, and those disks used which give a maximum volume delivery of approximately 3·5 gallons for summer and 2·5 gallons for winter use. For most guns disk-sizes of approximately $\frac{8}{64}$ in. and $\frac{6}{64}$ in. will be found suitable for summer and winter use respectively. For gun increased nozzle pressure is desirable, 300 lb. to 350 lb. being required for efficient working.

The volume deliveries of the spray-rods and guns indicated above are higher than are generally employed by growers and in some instances may be too great for the pump in use to supply. It is necessary, therefore, that the relationship between nozzle and pump capacity should be considered when determining the type of nozzle to be used (see this *Journal*, Vol. 52, p. 34).

---

# COCCIDIOSIS IN POULTRY.

L. W. N. Fitch, Veterinary Laboratory, Department of Agriculture, Wallaceville.

Coccidiosis is probably the most serious disease of fowls in New Zealand. It occurs in all parts of both Islands, and losses are frequently heavy. There are two main forms, caused by different species of coccidia. One species attacks young chickens, which may show serious signs of parasitism at the early age of ten days, and this attack, if survived, does not protect them from the second species which affects them as pullets, just at the age when they might be expected to be coming into production.

The cause of coccidiosis is a protozoan or unicellular organism of microscopic dimensions, known as a "coccidium." Its life cycle is of very great biological interest, besides being of practical importance from the viewpoint of control.

Coccidia have two methods of reproduction—sexual and asexual. The former enables the parasite to survive apart from its host, while the latter ensures its rapid multiplication and invasion of its host's tissues once infection has been achieved.

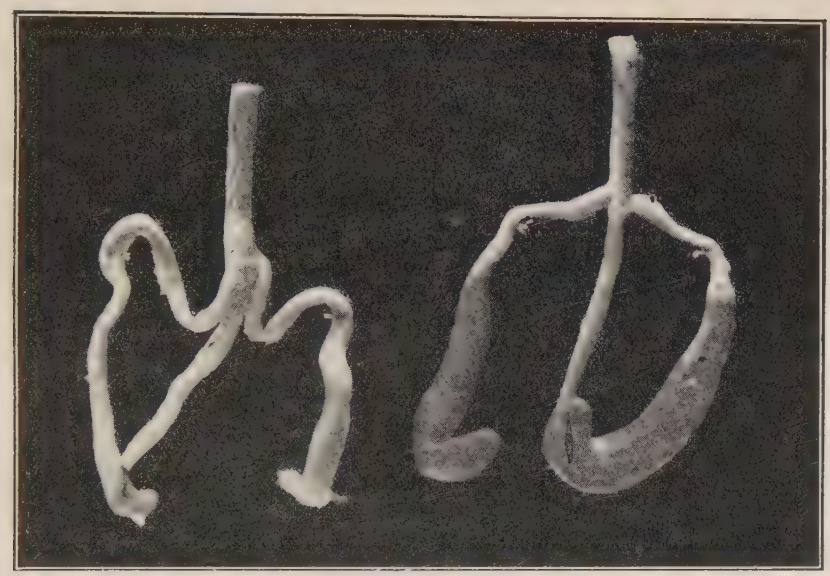


FIG. 1. SHOWING NORMAL (LEFT) AND AFFECTED (RIGHT) BLIND GUT TAKEN FROM CHICKENS.

Affected blind gut filled with blood-clots resulting from hæmorrhage from damaged lining.

FIG. 2. PULLET ACUTELY AFFECTED WITH COCCIDIOSIS.

Unable to stand upright owing to general debility.

### Life Cycle.

Briefly the life cycle of coccidia is as follows: The form found in the excreta is known as the oocyst. This is a small oval or round body which can be seen only with the aid of the microscope. The oocyst is covered with a protective membrane which enables it to withstand weathering for long periods—up to at least a year under suitable conditions. It will not withstand prolonged drying or sunlight. The oocyst contains a central mass of material known as the nucleus, which, under favourable conditions, divides into four parts (sporocysts), each of which again divides into two parts (sporozoites). The oocyst with its eight contained sporozoites gains access to the gut of a bird via its food or drinking water, and there the action of digestive juices breaks down the cell-wall and the sporozoites are liberated. These latter, being motile, are capable of invading the cells lining the wall of the intestine. Once in the cell the sporozoite enlarges and divides into a large number of small organisms (merozoites) which are liberated into the bowel and infest fresh cells. This is the asexual form of reproduction and that chiefly responsible for the multiplication of the parasites. A variation in the above sequence, however, results in the formation from merozoites which have invaded gut cells of two different forms, one male and the other female. The fertilization of the former by the latter, after their liberation from the cell into the lumen of the gut, results in the formation of an oocyst, which is the form excreted in the droppings and that responsible for the spread of infection. This represents the sexual form of reproduction.

### Symptoms of Coccidiosis.

The severity of the disease varies widely. In some outbreaks the course may be very acute, with sudden, heavy mortality. In others the course may be chronic, with progressive emaciation and losses spread over a longer period.

In young chicks the former type usually occurs. The birds suddenly begin to die, the chief symptoms being diarrhœa, with blood-stained droppings. This is very useful in diagnosis of the condition. It is due to the extensive damage done to the lining membrane of the blind guts (there are two cæca in the fowl). In this form of coccidiosis the infection is usually chiefly confined to this region. The livers, however, in some cases may be grossly affected, showing extensive mottling. This is due to damage caused by coccidia which have passed from the intestine to the liver via the bile-ducts. On post-mortem the blind guts will often be seen to be filled with blood-stained material, or even, in very acute cases, with actual blood. In others the cæca may be filled with an offensive smelling, pasty, yellowish material. In less acute cases the birds huddle together, become droopy and ruffled, and lose their appetite. Death is less sudden.

In older birds the onset is more insidious. The birds become unthrifty and pale. They lose weight and become emaciated, frequently showing a weakness of the legs. As against the case of young chicks, pullets are mainly affected in the upper part of the small intestine—(*i.e.*, that part immediately following the gizzard). Here, again, much damage may be done the bowel-wall, but the naked eye changes are not so obvious as in the acute type met with in young chicks. The bowel may be dilated and the lining membrane is covered with a catarrhal exudate, which gives it a rough, fluffy appearance when compared with the normal.

## TREATMENT.

It will be clear from the life cycle that there are two points at which we might direct our attack. The first is while the parasite is in the gut of its host, and the second is the sexual stage—the oocyst, which is excreted in the droppings.

It has long been realized that the first form of approach was of very limited value. Coccidia in the bowel are very resistant to drugs. Recently, however, two forms of medicinal treatment have been fairly widely advocated, and where more strenuous methods are impracticable, or conditions suitable, these might be attempted. The first of these measures consists of feeding large amounts of milk, the idea being that the contents of the intestines become more acid than usual, and thus the development of the infection is checked. The second involves the use of iodine. This is given in combination with milk, as follows: iodine, 1 part; potassium iodide, 2 parts; water, 50 parts.

This forms the stock solution which is prepared for use by mixing with fresh or skim-milk in the proportion of 1 part of stock to 9 parts of milk. This mixture is heated gently until it becomes white and added *ad lib.* to the drinking-water. The iodine-milk mixture should be made fresh daily.

It will be realized readily that the above measures only benefit the birds treated, and actually they only assist these to a limited extent. The birds still continue to excrete infective material, and it is at this stage that we must direct our efforts. Affected birds constitute a great danger, as they provide a source of reinfection for other birds.

It cannot be too strongly stressed that prevention of infection is by far more important in the control of coccidiosis than are curative measures. The source of infection must be removed, or, at least, limited as far as possible. All obviously infected birds should be destroyed and buried deeply, or, far preferably, burnt. They are a menace to the rest of the flock, and must not be kept. This is very important and a point which many poultry-keepers fail to appreciate. A sick bird is not worth anything in the market, and should be prevented from doing any more damage. Medicinal treatment is useless in acute cases, as also in advanced chronic cases showing emaciation. It may be of value in those cases of coccidiosis in which a diagnosis has been established in the laboratory, and where the symptoms are merely unthriftiness, unaccompanied by advanced emaciation. In such cases medicinal treatment should be combined with preventative methods.

Young birds should be reared on wire netting to minimize chances of reinfection from infective droppings. Droppings should be removed and buried deeply, or, preferably, burnt. This is to be done every two days, this being the time required for the oocyst to become infective.

Oocysts are very susceptible to heat, dryness, and sunlight. Boiling water with caustic soda, or the blow-lamp, are useful in cleaning brooder houses, shed-floors, perches, &c. These may be white-washed, or, in the case of perches and uprights, painted with boiling tar. Incubators, especially trays, should be washed with a 5-per-cent. carbolic-acid solution and allowed to dry.

Where possible, birds should not be run on infected country. Liming of surface soil and frequent turning to expose oocysts to sunlight is a useful measure. It must be remembered that oocysts may survive in soil under favourable conditions for at least a year.

Infected birds should not be removed to "clean" ground as they will rapidly contaminate it. Only newly hatched chickens from "clean" incubators and brooder houses should be put on to such new territory.

Where practicable, attendants handling infected birds should have no contact with healthy stock. Where this is impracticable, the attendant should thoroughly wash and disinfect hands and gum boots with a disinfectant solution, such as hypochlorite, before leaving infected premises.

In view of the possibility of eggs becoming contaminated by oocysts while passing through the cloaca, it is desirable to adopt some form of disinfection of eggs before incubation. Eggs should be washed in methylated spirits, allowed to dry, and then dipped in perchloride of mercury (a solution of 1 part in 2,000 of water) before setting them.

Finally, again it is desirable to emphasize the necessity for the most persistent and energetic measures in the campaign against coccidiosis.

---

# SPOTTED-WILT ON TOBACCO.

G. G. Taylor and E. E. Chamberlain, Plant Diseases Division, Plant Research Bureau, Palmerston North.

The virus disease spotted-wilt has already been recorded on tomatoes in New Zealand (Chamberlain and Taylor, 1936). For the past four seasons the same disease has been present on tobacco in the Auckland and Bay of Plenty Districts, where it has been known as "black-wilt." During the 1934–35 and 1935–36 seasons it has appeared on tobacco grown for experimental purposes at Palmerston North.

Although spotted-wilt is of world-wide distribution, the only record of its being of economic significance on tobacco is from South Australia (Samuel and Bald, 1933). It has, however, been recorded as causing losses of 35 per cent. in experimental plots at Perth, in Western Australia (Pittman, 1934). A disease causing heavy losses on tobacco in certain districts in South Africa may also be caused by the same virus (Moore, 1932 and 1933).

## Symptoms.

In the field the first symptom of spotted-wilt is the occurrence of necrotic areas on the young leaves. Necrosis spreads rapidly on the young growth, and the leaves at the growing-point become brown and withered (Fig. 1). At the same time growth ceases, so that infected plants soon appear noticeably stunted. The symptoms are most pronounced on young plants still in the rosette stage, for within a few days of the appearance of the disease most of the leaves show a marked necrosis and wilting (Fig. 2), and within a week or so the plants wither and die. On older plants a dark-brown or black streak appears on one side of the stem, and the top of the plant tends to curl over to that side (Fig. 3). Necrosis is at first present only on young leaves at the growing-point and on the older leaves on the side of the plant on which the streak occurs (Fig. 1). The more mature leaves, especially those at the base of the plant, often remain free from necrosis, but cease to grow and also ripen prematurely. Infected plants sometimes send out apparently healthy laterals, but these eventually develop spotted-wilt symptoms.

The foliage symptoms vary considerably. On young leaves necrosis first appears along the veins, but rapidly extends until the whole leaf becomes brown and wilted (Fig. 2). On older leaves necrosis often appears at first along the small veins, thus producing a network of bronzed tissue, but later spreads to form large necrosed areas (Fig. 4). Occasionally the only symptoms to appear are dark streaks along the larger

FIG. 1. SPOTTED-WILT ON TOBACCO.
An early stage of infection.
[*Photo by H. Drake.*

veins. On rapidly growing leaves the formation of such streaks is sometimes accompanied by a bending of the mid-rib to one side, thus producing a distortion of the leaf. The colour of the dead tissues varies from light brown to almost black. On the older leaves the symptoms are invariably more pronounced towards the base of the leaves (Figs. 1 and 4).

FIG. 2. SPOTTED-WILT ON TOBACCO.
Infection on a young plant. Healthy plant on left.
[*Photo by H. Drake.*

FIG. 3. SPOTTED-WILT ON TOBACCO.
Showing curling over of top. Plant grown in the glasshouse.
[*Photo by H. Drake*

## Incidence and Economic Significance.

Spotted-wilt first became of economic significance on tobacco in New Zealand at Pongakawa, in the Bay of Plenty, during the 1932–33 season. In that season up to 25 per cent. infection was reported from individual crops. Although the disease has been present each year since then, the losses have been slight. Spotted-wilt has also occurred for several seasons in commercial plantings at Auckland and Waikeria.

Diseased plants generally represent a total loss, since they rarely yield any curable leaf and infection usually takes place too late in the season for replacements to be made.

FIG. 4. LEAF SYMPTOMS OF SPOTTED-WILT ON TOBACCO.
Showing network of necrosed tissue and the formation of larger necrotic areas
[*Photo by H. Drake.*

## Identity with Spotted-wilt on Tomatoes.

During the investigations of spotted-wilt of tomatoes and of the so-called "black-wilt" of tobacco it was found that these two diseases produced identical symptoms when transmitted by artificial inoculations* to tobacco and tomatoes in the glasshouse. It would appear, therefore, that the disease on either host is brought about by the same virus.

* Throughout these investigations all transmission experiments were carried out by the leaf-rubbing method of artificial inoculation. For details of this method and a description of the symptoms of spotted-wilt on glasshouse-grown tobacco and tomatoes, see Chamberlain and Taylor (1936).

Table I gives the results of experiments on the transmission of spotted-wilt from tobacco to tobacco and tomatoes. In all cases the source of inoculum was naturally infected tobacco-plants collected in the field.

*Table I.—Artificial Transmission of Spotted-wilt from Tobacco to Tobacco and Tomatoes.*

| Date of Inoculation. | Locality.* | Species of Plants inoculated. | Number of Plants inoculated. | Number of Plants infected. | Inoculation Period. | |
|---|---|---|---|---|---|---|
| | | | | | Primary Symptoms. | Secondary Symptoms. |
| | | | | | Days. | Days. |
| 22/1/36 .. | Palmerston North | Tobacco .. | 12 | 6 | 4 | 8 |
| 14/2/36 .. | Pongakawa .. | ,, .. | 8 | 1 | 11 | 30 |
| 17/3/36 .. | ,, .. | ,, .. | 16 | 5 | 7 | 10 |
| 19/12/34 | Palmerston North | Tomatoes | 5 | 2 | .. | 23 |
| 22/1/36 .. | ,, | ,, | 12 | 11 | .. | 12 |
| 14/2/36 .. | Pongakawa .. | ,, | 8 | 2 | .. | 15 |
| 17/3/36 .. | ,, .. | ,, | 8 | 2 | .. | 11 |

* This column gives the locality from which the diseased material was collected.

Check plants equal in number to those inoculated all remained healthy.

## Methods of Spread, Host-range, and Overwintering.

Work in Australia has shown that spotted-wilt is spread by means of thrips. Two species were found to be responsible for transmission: *Thrips tabaci* (Pittman, 1927) and *Frankliniella insularis* (Samuel, Bald, and Pittman, 1930). Thrips have also been found to transmit the disease in both Europe and North America (Smith, 1931; Gardner and Whipple, 1934). In New Zealand *Thrips tabaci* is of common occurrence, and preliminary experiments have shown that it is able to transmit the disease.

Since spotted-wilt may be transmitted by juice inoculation it is probable that a certain amount of spread takes place during the handling of the plants.

Spotted-wilt has a very wide host-range, the following being a few of the more common plants of the flower and vegetable garden which have been listed as susceptible: Nasturtiums, asters, zinnias, iceland poppies, chrysanthemums, potatoes (Bald and Samuel, 1931), petunias, dahlias (Smith, 1932), and cinerarias (Ainsworth, 1933).

To date no transmission of spotted-wilt has been secured through the seed of any of its hosts. The short-lived nature of the virus outside living tissues precludes the possibility of transmission through the soil. It would appear, therefore, that the disease must overwinter either on annuals which grow through the winter or on perennial hosts, such as dahlias, iceland poppies, potatoes, &c.

## Control Measures.

Until such time as the natural host-range of spotted-wilt under New Zealand conditions has been determined the following control measures are suggested.

Crops should be examined regularly and all infected plants rogued as soon as the disease can be recognized.* Not only is it necessary

* At Pongakawa rogueing has been practised since the disease made its first appearance in 1933, and it is probable that this has been responsible for keeping the disease in check during the last three seasons.

to remove infected tobacco-plants, but tomatoes growing in the vicinity of the crops should be inspected also and diseased plants taken out. All infected plants should be burned or deeply buried.

After handling infected plants the hands should be thoroughly washed with soap and water before working with healthy plants.

Since secondary growth may become infected and assist in the overwintering of the disease it is advisable to plough out all plants as soon as the crop is harvested.

ACKNOWLEDGMENT.

The writers wish to acknowledge the help given by Mr. C. Lowe, Tobacco Instructor, Department of Agriculture, Auckland, who kindly forwarded material and supplied information with reference to the incidence of the disease.

LITERATURE CITED.

AINSWORTH, G. C. (1933): Eighteenth Ann. Rept. Cheshunt Exper. & Res. Stat., Hertfordshire, 1932, pp. 39–45.
BALD, J. G., and SAMUEL, G. (1931): Australia Council Sci. & Ind. Res. Bull. 54; 24 pp.
CHAMBERLAIN, E. E., and TAYLOR, G. G. (1936): *N.Z. Journ. Agric.*, Vol. 52, pp. 9–17.
GARDNER, M. W., and WHIPPLE, O. C. (1934): Abs. in Phytopath., Vol. 24, p. 1136.
MOORE, ENID S. (1932): *Nature*, Vol. 129, p. 544.
— —— (1933): S. Africa Dept. of Agric. Sci. Bull. 123; 28 pp.
PITTMAN, H. A. (1927): Journ. Council for Sci. & Ind. Res. (Australia), Vol. I, pp. 74–77.
——— (1934): *Journ. Dept. Agric. Western Australia*, Ser. 2, Vol. II, pp. 123–140.
SAMUEL, G., and BALD, J. G. (1933): *Journ. Dept. Agric. S. Australia*, Vol. 37, pp. 190–195.
SAMUEL, G.; BALD, J. G.; and PITTMAN, H. A. (1930): Australia Council Sci. & Ind. Res. Bull. 44; 64 pp.
SMITH, K. M. (1931): *Nature*, Vol. 127, pp. 852–853.
——— (1932): *Ann. of Appl. Biol.*, Vol. 19, pp. 305–330.

# THE FUNGI ASSOCIATED WITH MOULDY-CORE OF APPLES.

R. M. BRIEN, Plant Diseases Division, Plant Research Bureau, Palmerston North.

THE condition known as mouldy-core has been prevalent for many years in New Zealand on certain varieties of apples, notably Delicious and Cleopatra (Cunningham, 1925). During the 1934–35 season, mouldy-core caused serious losses in crops of Delicious apples grown in the Auckland District. This investigation was carried out to determine the fungi responsible.

## APPEARANCE OF THE CONDITION.

At the time of harvesting, the external symptoms on fruits infected with mouldy-core are sometimes difficult to detect, but often a slight yellowing of the ground colour on the base near the stem cavity is observed. This yellowing occurs in advance of the normal change of the ground colour from green to yellow. At a later stage premature ripening and drop of fruits and a slight bronzing of the skin round the

points of the crown indicate the presence of the disease. A longitudinal section of an infected apple reveals internally a zone of brown, decayed tissue in the region of the core. (Fig. 1.) The seeds and seed-chambers are usually covered with fungous hyphæ. In some cases the discoloured area enlarges until the entire fruit decays.

## Discussion of Literature.

Peyronel (1921) recorded a core-rot of apples and pears in Italy caused by *Trichothecium roseum* Link., where entry had been made by way of the calyx. Cunningham (1925) recorded mouldy-core in New Zealand on certain varieties of apples (Delicious and Cleopatra) which possessed a large open passage (calycine sinus) between the calyx and the core. He considered that the disease was not due to any specific

FIG. 1. MOULDY-CORE IN DELICIOUS APPLE.
Note the large open calycine sinus.
[*Photo by H. Drake.*

organism, as he had isolated species of *Penicillium*, *Aspergillus*, *Rhizopus*, *Botrytis*, and *Trichothecium* from infected apples. These fungi had made entrance through the open calycine sinus. Harrison (1935) carried out investigations into the cause of mouldy-core of Gravenstein apples in Nova Scotia, and showed that the percentage of infected fruits depended directly on the percentage of open core. This latter condition was attributed to rapid growth causing a break in the core tissues, leading to an opening in the calyx tube. The fungi present in apples so affected were found to be chiefly *Alternaria tenuis* Nees. and *Fusarium* sp.

## Experimental Method.

For the purpose of the present investigation, consignments of Delicious apples showing symptoms of mouldy-core infection were forwarded to this laboratory by the Orchard Instructor, Auckland,

from the Kumeu, Henderson, and Oratia districts. When these apples were examined it was found that, in addition to mouldy-core infection, a number showed codling-moth infestation, entry being made through the calyx. Isolations were made both from fruits showing mouldy-core alone and from those showing mouldy-core plus codling-moth. The fungi obtained were isolated on prune agar, and transferred to potato dextrose agar for identification.

## Results.

From upwards of 800 isolations made from Delicious apples, the following fungi were obtained:—

(1) From apples showing mouldy-core only: *Gloeosporium perennans*, Zeller *et* Childs, 89·8 per cent.; *Fusarium lateritium*, Nees. var. *fructigenum*, 5·1 per cent.; *Septoria* sp., 2·5 per cent.; and *Phoma* sp., 1·2 per cent.

(2) From apples showing codling-moth and mouldy-core: *Gloesosporium perennans*, 45·8 per cent.; *Fusarium* spp., chiefly *F. lateritium* v. *fructigenum*, *F. culmorum* (W. Smith) Sacc., *F. orthoceras*, Appel *et* Wollenw., 15·5 per cent.; *Penicillium* sp., 10·3 per cent.; *Cladosporium* sp., 4·6 per cent., *Alternaria tenuis* Nees., 6·6 per cent.; *Rhizopus* sp., 5 per cent.; *Epicoccum granulatum* Penz., 1·6 per cent.; and *Pleospora* sp., 0·8 per cent.

Of the above fungi, the following have been proved pathogenic on apple fruits in New Zealand (Brien, 1934): *Gloeosporium perennans*, *Fusarium lateritium* v. *fructigenum*, *Alternaria tenuis*, *Rhizopus* sp., and *Pleospora* sp.

## Incidence of Mouldy-core in the Delicious Crops at Auckland, 1934–1935.

An inspection of fifty-seven orchards in the Auckland District was made by Mr. W. K. Dallas, of the Horticulture Division, Department of Agriculture, Wellington. Delicious apples were selected at random from trees, from the ground, from orchard boxes picked by the grower, and from export rejects. Of 1,290 fruits examined, 40·8 per cent. showed mouldy-core infection. In addition, 82·2 per cent. of the total number of fruits examined showed open calycine sinuses, 16·7 per cent. almost closed and 1·1 per cent. closed.

## Conclusions.

Mouldy-core in apples is caused by fungi which penetrate the calycine sinus. Some varieties possess an open sinus, which allows entry of organisms to the core, so that mouldy-core is due primarily to a defect in variety rather than to any specific organism. This is in accordance with the findings of previous workers cited herein. In New Zealand this defect appears to be enhanced by climatic and environmental conditions, because mouldy-core is not as prevalent elsewhere. As infection occurs by the passage of air or water borne spores through the open sinus, it is possible for any of the fungi listed above to gain entrance and ultimately produce the mouldy-core condition.

Thanks are due to Mr. W. K. Dallas, of the Horticulture Division, for collecting field data, and to Mr. L. Paynter, Orchard Instructor, Department of Agriculture, Auckland, for forwarding specimens.

LITERATURE CITED.

PEYRONEL B. (1921): *Boll. mensile della R. Stazdi. Patalogia vegetale*, Vol. II, pp. 23–27.
CUNNINGHAM, G. H. (1925): Fungous Diseases of Fruit-trees in New Zealand. 379 pp.
BRIEN, R. M. (1934): *N.Z. Jour. of Agric.*, Vol. 48, pp. 143–149.
HARRISON, K. A. (1935): *Sci. Agric.*, Vol. 15, pp. 358–369.

# FARMERS' FIELD COMPETITIONS.

## OTAGO AND SOUTHLAND DISTRICT, 1936.

Fields Division.

OTAGO can rightly claim to be the home of Farmers' Field Competitions in this country, for records reveal the fact that competitions were conducted in this province as early as 1895. In that year Sir John Bennett Lawes, Bart., of superphosphate fame, presented a 50-guinea challenge shield for the best-managed farm of from 100 to 400 acres in Otago or Southland. The competition was judged by Mr. P. Pattullo, Inspector for the New Zealand and Australian Land Co., and was won by Mr. G. H. Gilroy, of Stirling.

In 1897 field turnip competitions were introduced, Joseph Fison and Co., Ltd., offering two silver cups for competition, one for the best 5 to 15 acres of turnips and the other for the best 16 acres or over of the same crop. Messrs. Donald Reid and Co. also offered two cups, while other trophies were forthcoming from Messrs. Nimmo and Blair, Messrs. Wright, Stephenson, and Co., and from the Otago A. and P. Society who were sponsoring the movement.

During subsequent years the number of classes increased year by year until in 1901 there were eight classes for various crops, principally swedes, turnips, and mangolds.

An interesting class introduced the first year (1895) was a reaper-and-binder trial held at Outram, which trial attracted three competitors. These three entrants were manufacturers of machines, and as it was apparently not the intention of the Otago A. and P. Society to encourage such competitors the conditions were the following year changed, and the competition was open only to farmers, and no paid servant of any maker or expert was allowed to be with the machine. This competition attracted eleven entries.

These various competitions as outlined were continued up until 1917, when, possibly on account of the international upheaval, they were discontinued. During the past eight or ten years, however, various competitions have been carried out in Southland, and during the past season competitions have been resuscitated in Otago.

One of the main competitions held in Southland is the Prize Farm Competition. The autumn judging of this competition has yet to be carried out, so the final results are not yet complete for the 1936–37 season.

In the root-crop competition in Southland this season there were thirty-nine entries of swedes and six entries of turnips. The areas judged of these crops are 4 and 5 acres respectively. The entries were received from over a wide range of Southland, being as far apart as

Freshford, Papatotara, and Waikaka Valley. First place in swedes was secured by Mr. Jas. Stevenson, Wendon, with a crop of 85 tons 8 cwt. Mr. R. W. Maher filled second place with a crop weighing 77 tons 9 cwt., while Mr. J. Wilson's crop of 71 tons 9 cwt. was third. In soft turnips Mr. A. O. Fleming was first with a 48 tons 8 cwt. crop, while Mr. C. C. Munro was second with a 44 tons 8 cwt. crop, and Mr. F. G. Clark filled third place with a crop weighing 42 tons 10 cwt.

As already indicated, field competitions were revived in Otago this season. A committee representative of the Farmers' Union, Otago A. and P. Society, stock and station agents, and the Department of

WINNING SWEDE CROP IN OTAGO COMPETITIONS.

Grown by Mr. C. Morrison, Inch-Clutha; yield, 95 tons 16 cwt. an acre.

Agriculture was set up, and this committee acts as the central executive for all competitions throughout Otago. Owing to the extremely wide variation in soil types in this province and the diversified nature of farming it was decided to divide Otago into zones and make each competition complete within its own zone. By this means it was hoped to even up matters so that competitors would not be unduly handicapped by soil type and other factors over which they had no control. While it is realized that such a zoning could be by no means perfect in its object, the results of the first year's competitions were satisfactory, and only minor anomalies occurred.

Classes for root crops, pastures, and live-stock were undertaken, and the measure of support afforded the competition in its initial year was very satisfactory. The only disappointing feature was the poor attendance of farmers at judging-time, but this feature of the work will grow as farmers come to realize the worth of competitions.

In the swede class there were forty-three entries extending over the Strath-Taieri, Inch-Clutha, Owaka, and Milton districts. The Inch-Clutha district, famous for its swede crops, easily headed Otago for crop-yields. The winning crop was that grown by Mr. C. Morrison, which weighed out at 95 tons 16 cwt. This is by no means the heaviest crop that has been weighed up in this district, swede crops in previous competitions having yielded over 100 tons per acre. When one realizes that these crops are in 28 in. ridges (as compared with the 14 in. and 21 in. drills commonly seen in the North) some idea of the excellence of the roots may be formed. The second heaviest crop this season was that of Messrs. Wilson Bros., which yielded 90 tons 11 cwt. per acre, while a second crop of Mr. C. Morrison's weighed 88 tons 18 cwt. The best crop in the Owaka district, grown by Mr. W. S. Bayne, yielded 58 tons 9 cwt., while in the Milton district a 47 ton crop grown by Mr. John Cameron topped the list, and in the Strath-Taieri district Mr. F. G. Glover was first with 61 tons.

The rules for the pasture competition were based on those adopted in Taranaki, but with minor adjustments to meet local conditions. For instance, the minimum area was increased from 3 acres to 10 acres, while the judging-points were also altered slightly. Good entries were received for the pasture classes, the districts competing including those of Central Otago as well as coastal districts, and the total entries were thirty-four. As the pastures have to be judged again in the autumn, no results of this season's pasture competition are yet available.

The live-stock competition this season consisted of a competition for ewe hoggets. Just as one or two roots in a winter show give no indication of the yield or utility of a crop, so it was felt that a small pen of ewe hoggets at an A. and P. show does not fully represent the quality of a farmer's flock. After all, it is the whole flock or farm unit that counts in farming, and not merely the cream of the stock or crops, and it was with a view towards bettering the quality of a flock as a whole that the ewe-hogget class was introduced. Having very little information as a guide, the committee had to draw up rules practically without precedent, and as a result of the first year's work it has been found necessary to make extensive alterations for the coming season. No stud sheep were eligible, and farmers had to submit to the judges a number of hoggets equal to 20 per cent. of the ewes put to the ram the previous season. There were two classes, one for ewe hoggets that in the opinion of the judges would build into a flock most suitable for the production of fat lambs and the other into a flock for straight-out wool-production. In the first class the points were—

| | |
|---|---|
| Suitability for production fat lambs | 50 |
| Constitution | 30 |
| Wool | 20 |
| Total | 100 |

while in the second class the points were—

| | |
|---|---|
| Wool | 50 |
| Form and constitution | 30 |
| Breeding and quality | 20 |
| Total | 100 |

In addition to these classes some districts introduced a special dual-purpose class, where the points were—

| | |
|---|---|
| Wool .. .. .. .. .. .. | 35 |
| Carcass .. .. .. .. .. | 35 |
| Uniformity .. .. .. .. .. | 30 |
| Total .. .. .. .. .. | 100 |

Four districts entered for the ewe-hogget competition, these being South Otago, Roxburgh, Maniototo, and the Lakes District. The total number of entries was fifty-seven.

The placings in the various districts were as follows:—

South Otago—

Fat-lamb Class—

| | |
|---|---|
| First .. .. | W. Craigie, Owaka. |
| Second .. .. | Miss McPhee, Owaka. |

Wool Class—

| | |
|---|---|
| First and Second .. | John Anderson, Waiwera. |

Dual-purpose Class—

| | |
|---|---|
| First .. .. | Chas. Begg, Pukeawa. |
| Second .. .. | D. McKenzie, Waiwera. |
| Third .. .. | W. Bradfield, Owaka. |

Roxburgh District—

Dual-purpose Class—

| | |
|---|---|
| First .. .. | F. Chittock, Kelso. |
| Second .. .. | H. Kirk, Kelso. |
| Third .. .. | Mrs. Potts, Crookston. |

Wool Class—

| | |
|---|---|
| First .. .. | F. J. Smith, Roxburgh. |
| Second .. .. | K. Wright, Roxburgh. |
| Third .. .. | G. Saunders, Roxburgh. |

Maniototo District—

Fat-lamb Class—

| | |
|---|---|
| First .. .. | Mrs. W. Blakeley. |
| Second .. .. | S. O. Neill. |

Wool Class—

| | |
|---|---|
| First .. .. | Paul Clark. |
| Second .. .. | W. Gibson and R. Gibson (equal). |

Dual-purpose Class—

| | |
|---|---|
| First .. .. | A. Stringer. |
| Second .. .. | G. Paterson. |

Lakes District—

Dual-purpose Class—

| | |
|---|---|
| First .. .. | D. Cockburn, Queenstown. |
| Second .. .. | J. L. Brown, Lower Shotover. |
| Third .. .. | Mrs. McLean, Queenstown. |

Wool Class—

| | |
|---|---|
| First .. .. | T. M. Houston, Lower Shotover. |
| Second .. .. | W. S. Reid, Arrowtown. |

The judging of the swede and pasture classes was carried out by officers of the Fields Division, while prominent breeders carried out the judging in the ewe-hogget classes.

# LAYOUT AND HOUSING FOR DAIRY-FARM PIGGERY.

## RECOMMENDATIONS OF THE MANAWATU-OROUA PIG RECORDING AND DEVELOPMENT CLUB.

W. J. CROUCHER AND E. P. NIELSEN, MANAWATU-OROUA PIG DEVELOPMENT AND RECORDING CLUB, PALMERSTON NORTH.

PIGS generally have shown that they are capable of earning a varying return under almost any type of housing-condition. In the main the tendency has been to put them on a piece of land unsuitable for other purposes, and to provide the least costly accommodation and equipment. Money invested in provision for pigs was not considered a live asset, and so little was invested. The pigs struggled along, yielded about half what they could yield, and the owner simply pocketed the returns as a matter of course and without any pride of achievement. Cows and sheep by contrast had money spent for efficient dairies, milking-machines, shearing-sheds, yards, and dips. Such conveniences made it easier to handle these stock, and enabled their full revenue-producing capacity to be exploited. With similar facilities pigs could show their worth and the owner be freed from some drudgery. Better conditions would make pigs more extensively profitable.

The guidance herein is based on actual experience of pig-raisers relative to the simplest and most economical means of securing breeding-stock, and management that will contribute to the quick growth and to the health of the pigs in every phase of their existence.

An important fact the truth of which has been clearly demonstrated is that no one feature alone will give complete success. It is not sufficient to rely upon the best of stock or type of pig if essential features of feeding and management are neglected. The best features of breeding, feeding, and management must be combined to secure consistently good returns, otherwise much well-intentioned labour and financial outlay may be without a suitable return.

Good housing is of fundamental importance in successful pig-raising, but it is of great practical moment to bear in mind also the well-proven fact that any expenditure on housing and in the runs attached thereto cannot give the desired results if the factor of common-sense control and management is not in evidence at all times, no matter how excellent the layout may be. Good management, independent of the strain and type of the pig, implies the wise application of acquired knowledge in every department, and particularly with respect to sensible feeding and management.

### SOME RESULTS OF POOR HOUSING.

It is a fundamental principle in successful pig raising and fattening that big litters of quickly maturing stock show the best returns in the shortest time; hence it is essential that the feed and comfort

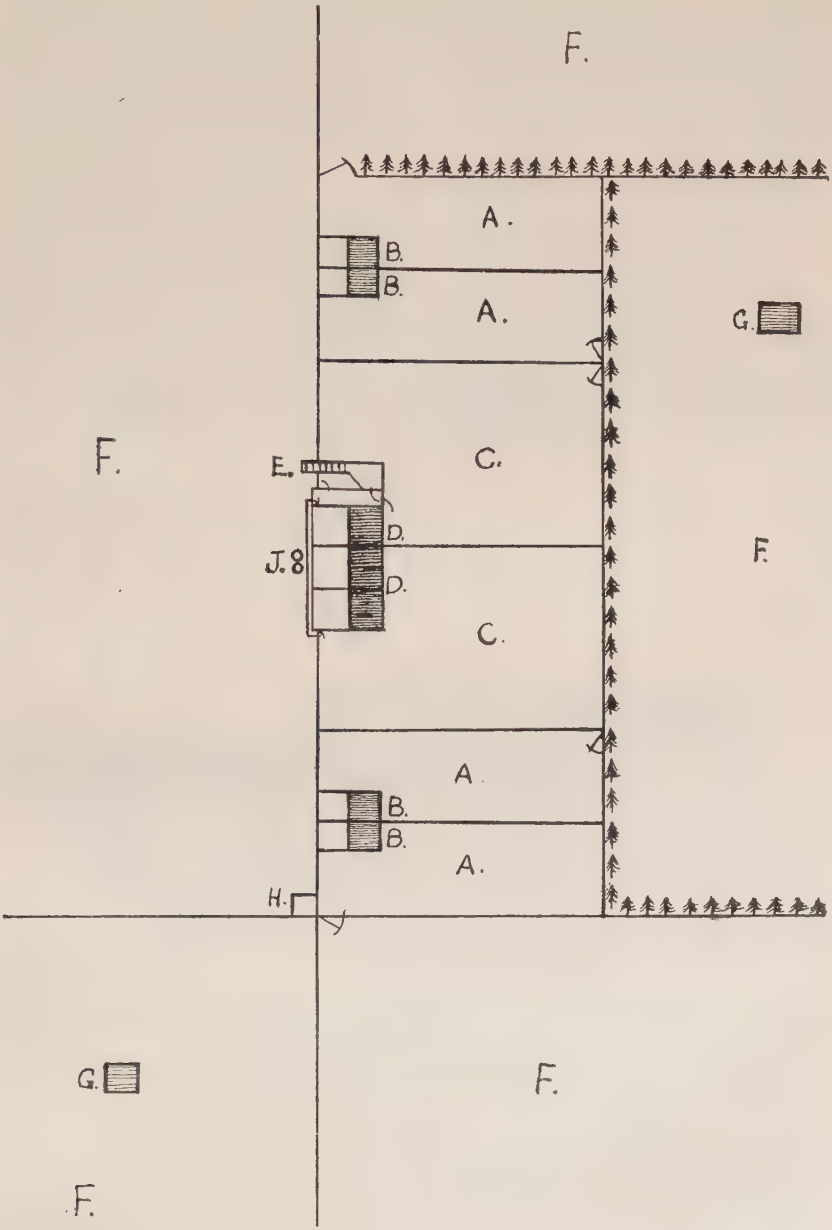



FIG 1. PIG-KEEPING LAYOUT NO. 1.

A. Small grass accommodation and control pens with farrow-house and feed-yards, with access to cow pastures.
B. Farrow-house and feed-yard.
C. Grass run-out pens for fattening pigs.
D. Fattening-house.
E. Drafting-yards and loading-race.
F. Dairy-cow paddocks.
G. Movable shelters for breeding-sows, &c.
H. Feed area for pigs on cow pasture.
I. Skim-milk pumped to this point for central feeding.

of the pigs be studied at all times. Bad housing usually means unthrifty and unhealthy pigs. An enormous loss arises because of disease, most of which is preventable. Cold, wet, and insanitary conditions invite trouble which can be avoided. The present heavy loss from mortality in young pigs should be eliminated. Pigs are very susceptible to pulmonary diseases, of which pleurisy and kindred troubles are very prevalent. Foul and insanitary yards,

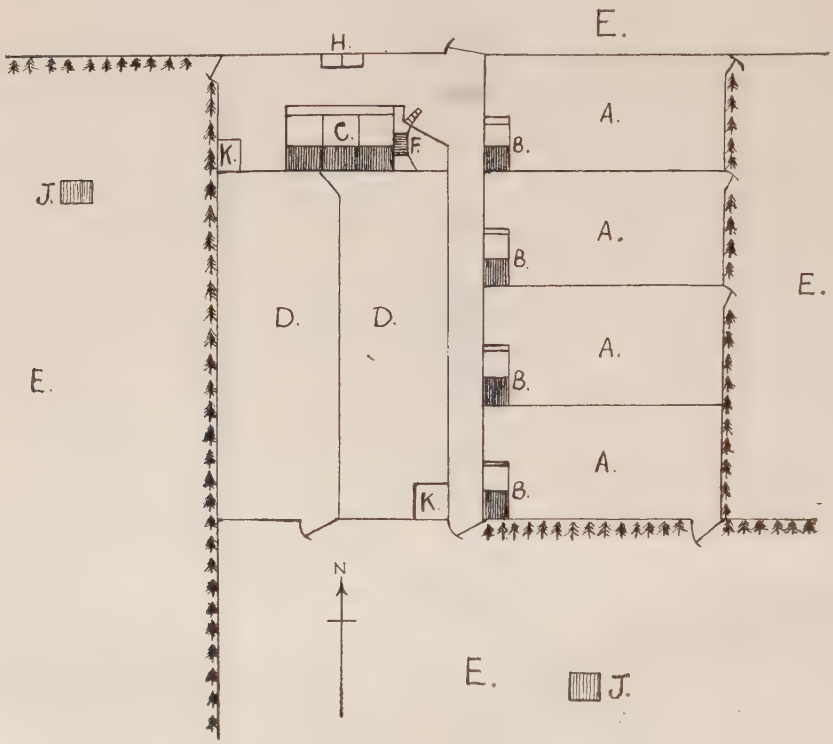



FIG. 2. PIG-KEEPING LAYOUT NO. 2.

A. Small grass accommodation and control pens attached to farrow units, with access to cow pastures.
B. Farrow units consisting of house, feeding-yard, and creep.
C. Fattening-house.
D. Grass run-out pen for fattening pigs for exercise, health, and control.
E. Dairy-cow paddocks and pastures for use of dry sows, sows and litters, young pigs until ready to place in the fattening-house, and for store pigs.
F. Drafting-yards, scales, and loading-race.
H. Meal-shed and copper.
K. Concrete or metal feeding-areas for pigs on cow pastures.
J. Shelters for pigs on cow pastures.

sties, troughs, and wallows are ideal breeding-places for intestinal worms and other pig-parasites. Care in trying to produce healthy pigs under filthy conditions is often in vain, and although some succeed in producing good pigs under dirty conditions they are getting less for their feed than it is capable of producing. There are numerous cases in which money spent on equipment that makes

cleanliness possible has been returned in the first season by a reduction in actual deaths on the farm or in the number of pigs condemned at slaughter. Pigs and filth need to be separated.

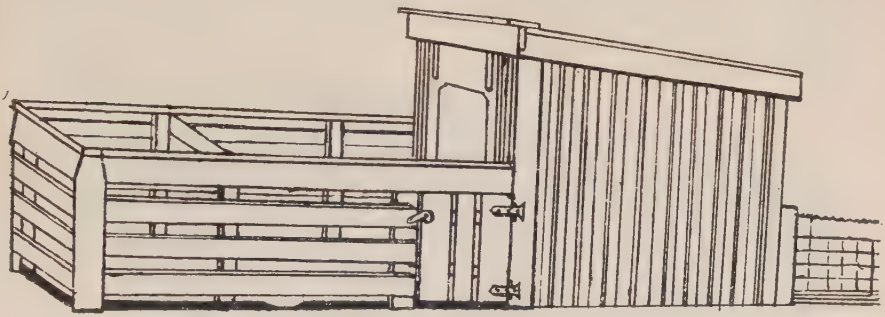


FIG. 3. FARROWING-UNIT: TYPE 1. SEMI-CLOSED FRONT; POST AND RAIL YARD.

House: 7 ft. 6 in. deep by 7 ft. wide by 6 ft. high front, 5 ft. back. Front boarded in at sides for 18 in.—also top.

Timber: 8 ft. by 1 ft. rough heart rimu; 3 in. by ½ in. slats; 4 in. by 2 in. joists, 3 ft. by 2 ft. purlins, rafters, and studs.

Flooring, preferably tongued and grooved, with not less than 3 in. fall to concrete yard. Farrow rail provided.

Roofing: 4 sheets 8 ft. iron, lined with tarred paper, felting, or sarking, supported by wire-netting

FIG. 4. FARROWING-UNIT: TYPE 2. OPEN FRONT, OVERHANG FORWARD; ROOF SLOPED TO FRONT; CLOSE-BOARDED YARD.

House: Specifications same as above—alternate timber—rusticating.

Yard, concrete: 8 ft. by 7 ft. overall. Creep 2 ft. 6 in. by 7 ft. Fall from house to corner and out of grass pen. 2 in. concrete kerbing, or lip, right round to prevent soiling of ground. Drainage to come into race to sump or open drain.

Railings: In type 1, 6 in. by 1 in. O.B. 3 ft. high. Creep partition preferably movable. In type 2, close-boarded yard: this more suitable for cold districts and unsheltered piggeries.

## General Requirements.

Any system of housing should give efficiency at a reasonable cost. It is most important that the sleeping-quarters be rainproof and windproof. The walls should be constructed so as to prevent cold draughts of air reaching the pigs. The house should face the sun and give free access to its rays and fresh air. Provision for carrying off foul air should be made by ventilators placed at the top of the back wall. Fattening pigs should be provided with an out-run where they can get exercise when kept under the close-pen system. In the absence of grass runs green feeding-material should be placed

in the sty. The series of plans for buildings and out-runs given herein is considered sufficient to cover the needs of every pig-keeper according to the size of his farm and the numbers of pigs handled. Individual judgment must be exercised in adapting the layout to the particular conditions of the farm with due regard both to efficiency and cost.

FIG. 5. FARROWING-UNIT: TYPE 3. CLOSED TYPE OF HOUSE, TWO SIDES WITH HINGED DOORS FOR SUN IN GOOD WEATHER.

House: Same overall specifications as in Fig. 4. Front and one side with top half hinged to open to sun and close in cold weather. Warmer type.

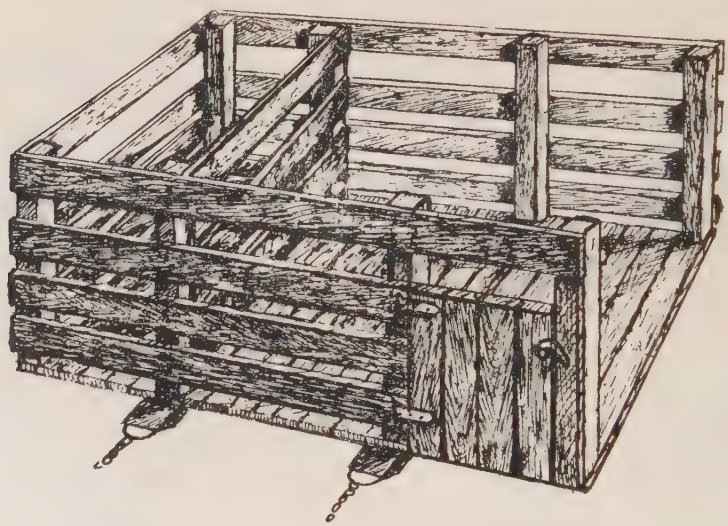


FIG. 6. FARROWING-UNIT: TYPE 4. DETACHABLE FEED AND CONTROL YARD FOR FITTING TO MOVABLE FARROW-HOUSE OF ANY OF THE ABOVE TYPES. TO BE SET IN COW PADDOCK.

No small grass pen attached. Specially recommended for man with two or three sows.
Yard: Detachable on skids with wood floor; same specifications.

## DRAINAGE.

In heavy lands good drainage from the sties and yards is a first essential. All fattening-houses should be provided with a narrow, concreted drain to carry all excretions to a sump from which the sewage can be taken and distributed as top-dressing for pastures

or carried away by an underground drain to some convenient place. A small catchment sump for the farrowing-pens is also advisable. Sows and litters fed with large quantities of liquid food are likely to make the ground near the house very wet, and to make a wallow

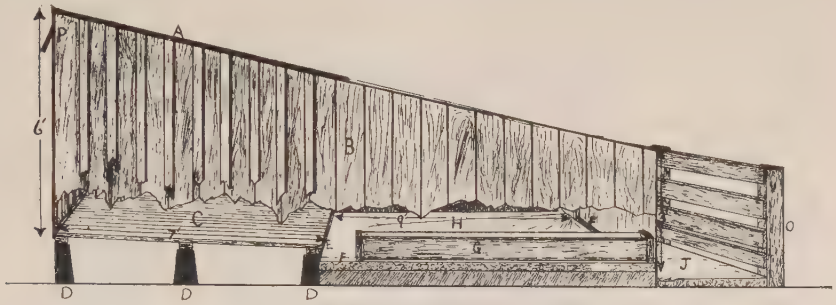



FIG. 7. FATTENING-HOUSE: SIDE VIEW.

A. Roof sarked with roofing-felt, and sloping into pen; 8 ft. iron.
B. Close-boarded walls, with slats over cracks as far as sleeping-board; close-boarded walls between pens.
C. Tongued and grooved sleeping-floor with a fall of 1 in. to the foot. This appears to be a steep fall, but in practice is ideal.
D. Concrete or wood piles.
E. Floor 4 in. above the yard.
F. Concrete kerbing.
G. Trough.
H. Concrete-floor level along wall for the trough, and sloping from house and trough towards door in far corner at the rate of 1 in. to the foot.
J. Concrete pathway 3 ft. wide with drain.
O. Fence 3 ft. high, making for the easy handling of the pigs.
P. Louvre, for good ventilation.

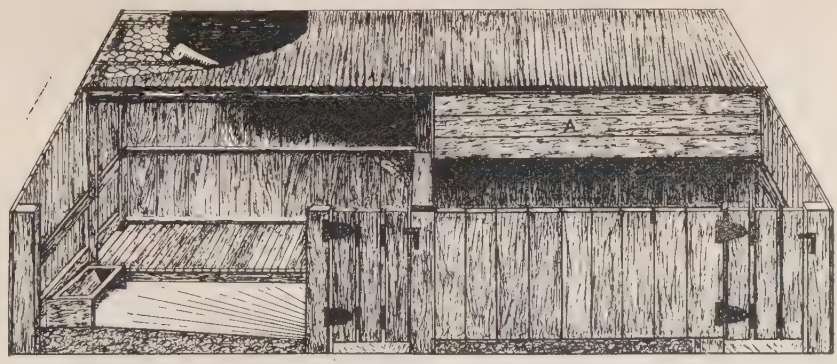



FIG. 8. FATTENING-HOUSE: FRONT VIEW.

A. Hinged door 1 ft. 6 in. deep, which can be folded under roof in suitable weather, as shown in adjoining pen.

Shows the construction of interior with trough-level along wall and concrete pen sloping to doorway. The steep fall on house floor and pen make this a simple house to keep clean. The roof is shown with netting and felt.

NOTE.—The above design and specifications are submitted as suggestions which the farmer can modify and improve to suit his particular conditions.

of their own urine. This endangers the health of the young pigs. All stagnant waterholes must be regarded as dangerous, because they are infested with germs of disease which are responsible for heavy mortality in pigs of all ages and particularly in young ones.

## Shelter and Shade.

A distinct weakness common in pig-keeping is the absence of shelter, for animals of all ages, when not styed, from the ill effects of cold winds or from the heat of the sun. A belt of trees some little distance from the pig enclosures tempers the cold blasts, but

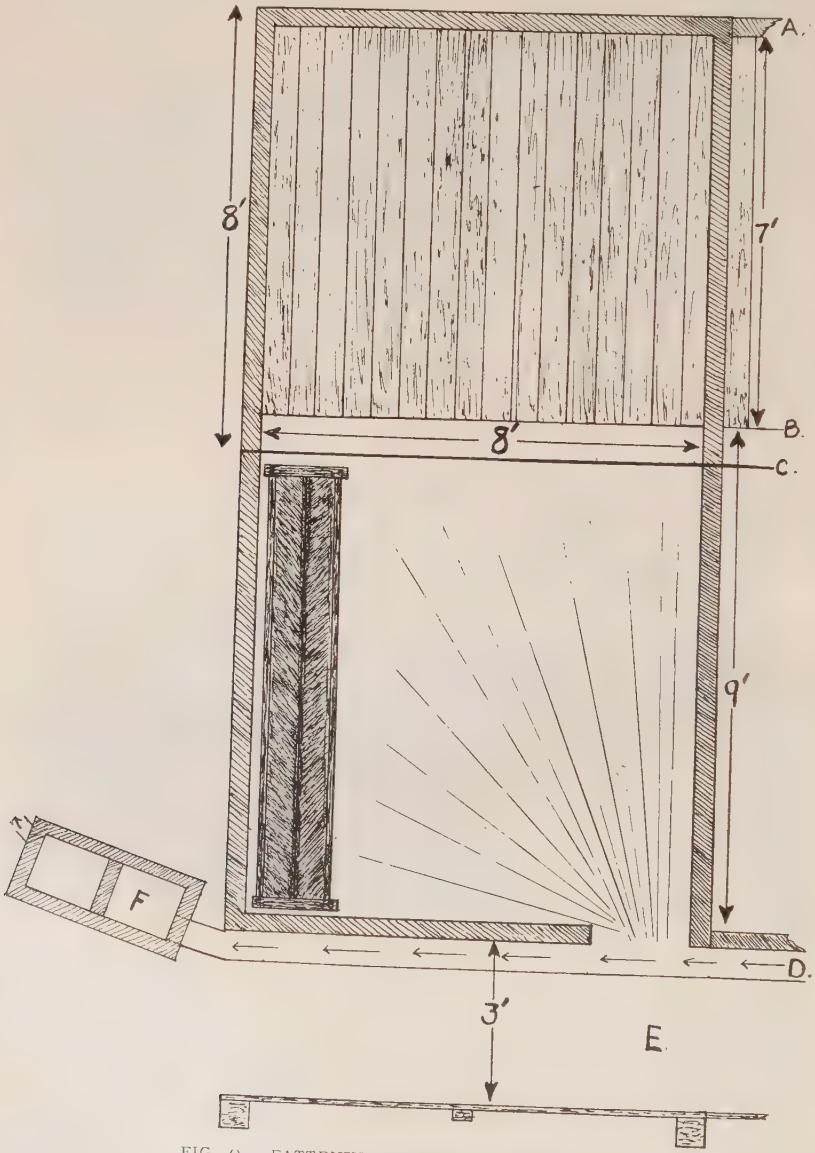



FIG. 9. FATTENING-HOUSE: GROUND PLAN.

A to B. Sleeping-floor.
A to C. Roofed over.
D. Drain to sump.
E. Pathway 3 ft. wide (concrete).
F. Sump.

no shelter is so effective for this purpose as a close-bottomed live hedge alongside the boundary and dividing fences of the pens. Any quickly growing hedge-plant is suitable for this purpose if kept well trimmed to ensure dense growth. Easily grown plants that have proved efficient are flax, pampas, and toetoe. Any tree such as the weeping willow planted in the enclosures will give shade. Alternately a rough frame resting on posts and covered with straw or branches of trees is very effective, especially when the sides facing the prevailing winds are boarded up. Close observation has shown that the growth and fattening rate of pigs is greatly retarded where they are kept under the paddock system and unprotected from the extremes of weather. Partly because suitable shelter so often is lacking, a recommendation herein is the use of a fattening-house with a small exercise yard attached as a separate unit of the layout along lines which already are giving very good results.

In general, the accompanying plans of the piggery layout and buildings are self-explanatory, and can be adapted to suit a wide range of needs. All outside pens give access to the cow pastures: this allows of extensive grazing, which is regarded as an integral part of economical pig-raising.

As indicated by J on the layout plan, shelter-houses are provided for pigs on cow pastures. These shelter-houses are similar to types 1 and 2, except that they have no fixed feeding-pen or creep. Where only a few sows are kept, these houses can be readily converted into complete farrowing units by using a detachable yard as shown in type 4.

---

## DIGGING, PITTING, AND GRADING SEED-POTATOES.

C. C. Leitch, Instructor in Agriculture, Timaru.

Investigation in this country shows that one of the diseases which probably causes the heaviest loss in potatoes after digging is dry rot. This disease generally has its beginning where potatoes have been injured in the lifting or digging. If the potatoes were not injured this disease would not be able to gain access to the tissues of the tuber, and thus the loss would be avoided. This point is borne out by the fact that when a bag of potatoes is tipped out only those tubers that have been damaged in some manner or other are affected with dry rot. Those with the skin unharmed are generally sound. Damage is likely to occur in digging, pitting, and grading.

*Digging* can be done either mechanically or by hand. To-day, because of the difficulty experienced in obtaining the services of expert fork diggers, the mechanical digger is mainly used. Of the two methods, it seems that hand digging by experts probably causes the least damage.

The main factors causing damage during hand digging are—(*a*) rough conditions and weed-growth, (*b*) hard-set ground, (*c*) uneven depth of planting, (*d*) uneven spacing. These factors operate also to a certain extent in mechanical digging.

One valuable feature in hand digging is the fact that only one or two tubers at a root are injured, and these are easily noticeable and can be avoided in the bagging-up process.

With the mechanical digger there are several circumstances in addition to those already mentioned where serious injury may occur. If the rows are not correctly spaced it is possible for one wheel of the digger to run along the edge of a row with the result that quite a number of tubers are crushed. Then, again, if the digger is not kept at a sufficient depth the potatoes are sliced. Although both the results mentioned can be avoided if proper care is exercised by the operator of the machine, the proportion of damaged tubers is almost certain to be larger than on a hand-dug area.

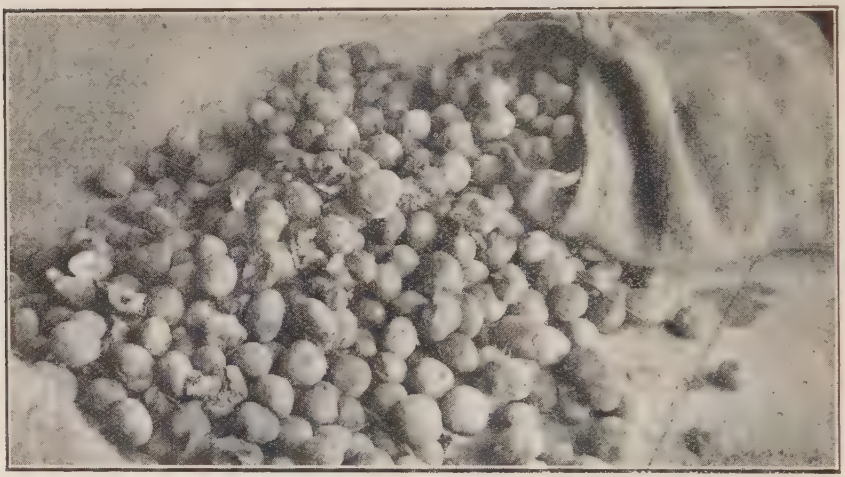


FIG 1. THE RESULTS OF DAMAGE TO THE TUBERS DURING HARVESTING.

The main damage, however, occurs on the "aprons" which convey the dirt and potatoes out of the ground. In order to free the potatoes from the dirt these "aprons" are agitated by means of sprocketed rollers. Most mechanical diggers have a second "apron" similarly agitated. It is here that most of the damage takes place, as, by this time, the potatoes are free from dirt and are being bumped over the bars with no protection. As a consequence bruising is very common, and, although sometimes apparent to the eye, the damage at this stage is not readily noticeable.

Another cause of damage is the digging of the crop before it is properly matured. In this case excessive skinning takes place, thus predisposing the tubers to attack by the dry-rot organism.

In order to minimize the damage caused by mechanical digging some growers take the precaution of putting strips of rubber (old car-tubes) along the two sides, thus breaking the fall and throwing the potatoes more into the centre of the second "apron." Other precautions taken are the removal of the agitator roller and its replacement by a plain roller, and in cases where the earth is dry and the potatoes free from dirt when they reach the top of the first "apron" the second one is removed altogether.

*Pitting.*—Damage may take place in various ways at pitting, such as—(*a*) rough handling by dumping into the pit; (*b*) allowing moisture to get into the pit by faulty covering and thus increasing the risk of frost injury; (*c*) insufficient ventilation; and (*d*) allowing too much dirt to get into the pit.

Some growers stack their potatoes in sacks, and there is no doubt that this method has much to recommend it. It may be slightly more expensive, but the potatoes are easier to handle, and if any bag is improperly filled it does not get mixed with the rest, and is easily detected.

With the introduction of hay-balers another method has come into vogue, growers using baled straw as the sides of their pits. This makes quite an effective pit, care being necessary to make certain that the covering over the top is proof against all weathers.

*Grading.*—Grading can be done either by hand or with a mechanical grader. No injury takes places in hand grading, but the process is rather slow. The mechanical grader is a most prolific source of injury. The machine is constructed on the cradle system, and the tubers are sorted into their grades by means of different-sized riddles. These riddles are constructed of corrugated wire which gives a rough surface for the tubers to travel over, and this is certainly the cause of most of the damage. The actual operation of the grading-machine is also a matter which requires expert knowledge. The riddles must be kept full to avoid excessive bumping. Grading machines, when bought, are "set," but in many cases the angle is not sufficient to ensure the forward movement of the tubers on to the elevator. This arresting of the forward movement causes unnecessary jarring and consequent bruising.

One method which has been tried to obviate this bruising is the substitution of wooden slats for the riddles. These slats, being triangular in their original form, and then rounded on top to prevent bruising on the sharp edges, allow the tubers to drop through without jamming. There are no cross-pieces to cause bumping as in the case of the corrugated-wire riddles.

If a riddle made of rubber or some soft but rigid substance could be introduced, this would minimize the damage to a great extent.

There is one very simple machine in operation which should go a long way towards reducing grading damage. The tubers in this case are hand-graded, but, instead of the grader going to the tubers, the tubers go to the grader on a moving table by means of a shute, the flow of tubers being regulated at the mouth of the shute by means of a rubber band of sufficient elasticity to preserve an even feed. The grader stands on a platform, picks off the damaged and misshapen tubers as they move along, and also grades into required sizes.

The foregoing is a brief outline of some of the factors which contribute to the injury of tubers during the handling of the crop. If the grower can be made to realize that the matters outlined above are the real source of most of his troubles, and that they must be eliminated before he can expect better results and returns, then a further step will have been taken in the direction of improved seed production.

---

The following weeds have been declared noxious weeds in Waipawa County: African boxthorn, hemlock, star thistle.

# CLOVERS IN PERMANENT PASTURES UNDER CANTERBURY CONDITIONS.

## THE RELATIVE PALATABILITY FACTOR.

A. H. FLAY, Canterbury Agricultural College, Lincoln.

THE medium, light, and poorer soils of Canterbury comprise an area of several million acres. On all these soils the problem of establishing adequate clovers as a component part of newly sown permanent pastures is very real. Some of the factors(1) that assist establishment are spring and early summer sowing, a well-fallowed seed-bed free from weeds and well consolidated, and the use of adequate lime and superphosphate. Early grazing-management so that the new pasture is not eaten short or allowed to get out of hand is also of value. The relative palatability of the species that make up the sward and the need for spelling or very light grazing at certain times to allow development of the lesser or more readily eaten constituents in the sward, however, has not received sufficient consideration.

In the past when almost every Canterbury farmer was sowing temporary rye-grass and attempting to secure a permanent pasture from it he generally grew satisfactory clovers, especially in the second and third years of the life of the sward. Red clover, and sometimes alsike and white clover, were sown in these pasture seed-mixtures. These pastures were of high quality for one, two, or three years. In the first year sheep thrived well and fattened on the relatively more palatable false perennial rye-grass in the sward. This rye-grass, in consequence, was grazed more severely than the clovers, with the result that the clovers made a good development into the second year, and sometimes into the third, by which time they usually contributed the bulk of the grazing. The red clover generally commenced to weaken in the second and third year, and then it would be grazed harder than the invading and less palatable hair-grass, sweet vernal, brown-top, &c., and consequently would soon die out. Ordinary or stubble white clover very largely shared the same fate as the red clover.

Recently, permanent perennial rye-grass of relatively lower palatability than the temporary type has been sown in the grass seed-mixtures by most farmers. This permanent rye-grass appears to be less palatable than the clovers sown with it. Further, it is much more persistent, with the result that the clovers have less opportunity to develop, especially in the first and second years of the life of the sward. Because of this palatability factor, the clovers in this permanent rye-grass sward are eaten first in preference to the rye-grass. Whilst stock (sheep) are being kept on the area to eat down the rye-grass, the consequent hard grazing of the clovers soon reduces their vigour, with the result that at the end of the first year in the life of the new pasture there are few clovers. As well as hard grazing, dry weather, in recent seasons, has assisted in reducing the clover content of many pastures.

It is commonly believed that true perennial rye-grass must be kept grazed moderately bare to secure the highest carrying-capacity and to obtain the best sward. Although this may be true on heavy land and in districts of high rainfall where heavy top-dressing is practised, it does not hold for Canterbury's poorer and lighter soils.

Assuming a spring, summer, or early autumn sowing, a new pasture may be grazed in the usual rational fashion until toward the end of October. This implies that the newly establishing sward is never kept grazed even moderately short for any length of time. By October or early November the rye-grass begins to shoot to seed, and, on all soils except the best, it becomes tough, hard, and distinctly unpalatable compared with the succulent clovers in the sward. By November, also, if not earlier, the accumulated fertility built up during the fallow prior to sowing has probably been used up, with the result that the rye-grass, which at first grew rapidly, providing reasonably luscious, palatable feed, now grows much more slowly. Slowly growing true perennial rye-grass under low-fertility conditions is distinctly unattractive to stock.

Under Canterbury conditions, then, with the soil also probably becoming steadily drier as the summer is approached, everything favours a slowly growing, stalky, hard, and tough unpalatable true perennial rye-grass. The lower the fertility the more pronounced is this development. It is at this stage that attempts are often made to graze the rye-grass closely "*to control it*," whereas the best treatment the rye-grass could receive would be little or no grazing at all, so that the clovers would not be severely treated and perhaps killed by the hard grazing before they are properly established. Without clover development there is little chance of securing an improved growth in the rye-grass. The statement(2) "without white clover rye-grass won't grow" is very true for the medium, light, and poorer soils of Canterbury.

The grazing-management, then, during November, December, and January on the newly establishing permanent pasture should consist of no grazing at all if clover-growth is poor, or a very light grazing so that a good clover-growth takes place. Often a two-month period of such special treatment is sufficient. This spelling should not be such that lodging of clovers takes place, and on the better soils it would consist of light grazing rather than entire spelling. The poorer the soil the greater the need for clover development, and hence on poor soils spelling for at least two months is practically essential. It is an advantage to have 6 in. to 12 in. of ordinary or Montgomeryshire red-clover growth for lamb or other feed in January or February: white clover is given a chance to fill out and develop, and subterranean clover is allowed to seed profusely in its first season.

It is true the rye-grass will run to seed during the light grazing or spelling stage. This is no disadvantage as far as has been observed over a period of several seasons in Canterbury. Often light hay crops of rye-grass and clover have been saved, rye-grass seed where the clovers have been poor has been reaped, and where clover-growth has been good such stands have been mown and header-harvested. More frequently on poorer soils the clover-growth has been used for feed in January and February for lamb-fattening, &c.

A sward consisting of ordinary or Montgomeryshire red clover, certified white clover, and subterranean clover, along with true perennial rye-grass and cocksfoot, properly sown, top-dressed, and given the grazing treatment discussed above, not only produces for a greater number of years and gives a higher carrying-capacity, but also provides a much more palatable and luscious true perennial rye-grass than a pasture in which clovers are not allowed to develop. With this grazing treatment for a year or two and its consequent improved clover-growth the palatability problem sinks into the background.

Without clover development true perennial rye-grass may be condemned as not being a high-quality feed. With poor or no clover-development on the medium and poorer soils, it takes three or four years for true perennial rye-grass to pass through the weak, pale, tough, and distinctly unpalatable stage. By this time the invasion from and development of inferior species may be such that they are the dominant species in the sward.

Under Canterbury conditions grazing should be such that pastures are spelled periodically to allow clover development. In the first year of the life of the pasture this is imperative. It is very hard, close grazing that allows the sheep to eat out the relatively more palatable clovers often before they are established and in preference to the relatively less palatable true perennial rye-grass.

---

REFERENCES.

(1) CALDER: "Clovers in Canterbury Pastures." *N.Z. Journal of Agriculture*, Vol. 53, No. 4; October, 1936.

(2) SMALLFIELD: "Pasture Establishment on Pumice Land: Experience and data from Recent Development Work." *N.Z. Journal of Agriculture*, Vol. 47, No. 6, December, 1933.

(2) —— "The Importance of Cultivation in Pasture Establishment." *N.Z. Journal of Agriculture*, Vol. 49, No. 6; December, 1934, p. 353.

'CERESAN'
BAYER'S DRY SEED DRESSING
(U.T. 1875 a) TRADE MARK

BRITISH MADE BY »Bayer«
gives:—
BETTER GERMINATION
BETTER CONTROL OF DISEASES
BIGGER YIELDS OF A
BETTER TYPE OF GRAIN

By treating your seed WHEAT, OATS, BARLEY and other crops with 'CERESAN' before sowing, you insure your crop against disease ravages and poor yields.
'CERESAN' TREATMENT MEANS GREATER PROFITS.

BAYER

SOLD BY STOCK AND STATION AGENTS AND GRAIN MERCHANTS

ORDER NOW!

Costs Less Than 1/- Per Acre

## SEED-WHEAT CERTIFICATION.

FOLLOWING is a list of growers whose wheat crops have passed both the field and grain inspection required under the Government scheme for the certification of seed wheat. The seed from these crops is not recognized as finally certified until it has been satisfactorily machine-dressed, and the sacks have been suitably sealed and tagged. (Previous lists appeared in the March and April issues of this *Journal*) :—

| Variety. | Grower. | Acreage. |
|---|---|---|
| Cross 7 .. .. | Bell, J. R., Morven .. .. .. .. | 40 |
| | Callaghan, J. A., Methven .. .. .. | 20 |
| | Canterbury Seed Co., Leeston (Line C) .. .. | 24 |
| | Corbett, E., Waikakahi Road, Waimate (Line C) | 18 |
| | Dore, W. J., Fairlie .. .. .. .. | 20 |
| | Evans, H., Masterton .. .. .. | 8 |
| | Hampton, J., Lauriston .. .. .. | 33 |
| | Hill, H., Geraldine .. .. .. .. | 8 |
| | McCaw, W. T., Tycho R.D., Timaru (Line B) .. | 10 |
| | Parnham, T. R., Whiterock, Rangiora R.D. .. | 11 |
| | Relling, H., Tycho, Timaru .. .. .. | 15 |
| | Stevens, E. H., Anama, Ashburton .. .. | 15 |
| | Talbot, P. R., Claremont, Timaru (Line B) .. | 8 |
| | Wells, T. M., Rakaia .. .. .. | 12 |
| Dreadnought .. | Henshaw, F. J., Studholme Junction .. .. | 10 |
| | Sansom, J., Section 4, Kormacks .. .. | 6 |
| Hunters II .. | Gibson, A., Tycho Timaru (Line A) .. .. | 9 |
| | Gibson, A., Tycho Timaru (Line B) .. .. | 6 |
| | Kavanagh, Mrs., Ryans Road, Upper Riccarton | 10 |
| | Murphy, R. J., Pleasant Point .. .. | 27 |
| | Robinson, R. P., Waikuku .. .. .. | 16 |
| | Ryan, E. P., Sutherlands .. .. .. | 23 |
| Solid Straw Tuscan | Canterbury Seed Co., Leeston .. .. | 15 |
| | Catherwood Estate, Springbank, Rangiora R.D. | 54 |
| | Coup, R. A., St. Andrews .. .. .. | 12 |
| | Hunter-Weston, R. P., Albury .. .. | 12 |
| | Lyon, C. R., Temuka .. .. .. | 5 |
| | McHugh, P., Estate of, Darfield (Line A) .. | 30 |
| | McHugh, P., Estate of, Darfield (Line B) .. | 10 |
| | White, G. T., Waiau .. .. .. | 18 |
| | Wilkinson, V., Mitcham .. .. .. | 6 |

—*Fields Division.*

## INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 11th March, 1937, to 22nd April, 1937, include the following of agricultural interest :—

No. 77282 : Hay-sweep attachment ; J. McL. Davidson and O. Omundsen. No. 77304 : Tractor ; H. G. Ferguson. No. 75011 : Egg-packer ; F. Francis. No. 75430 : Treating seed ; G. E. Heyl. No. 75612 : Citric soluble phosphate ; G. Arkinstall. No. 76012 : Centrifugal cream-separator. No. 76070 : Releaser flap ; R. McIntyre. No. 77309 : Flame-producing apparatus : The Eclipse Spraying Co., Ltd., and W. Grimley. No. 77417 : Egg-cooker ; J. Ewart. No. 76072 : Teat-cup ; J. Treloar. No. 76131 : Switch for meat-rails ; Auckland Farmers' Freezing Co., Ltd. No. 76791 : Bracken-destroyer ; V. H. Holt. No. 76361 : Concrete fencing-post ; H. S. Waters. No. 77072 : Mower ; W. Aston.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price, 1s. prepaid.

# SEASONAL NOTES.

## THE FARM.

### The Pastures.

On most farms there are one or more grass paddocks which are more suitable than the majority of the paddocks for providing late winter and early spring feed, especially if they are suitably managed. As a rule these are the paddocks which are well drained, which carry pastures containing a good deal of rye-grass, and which possibly are provided with some shelter. Such paddocks in particular should be harrowed if droppings have accumulated, top-dressed in good time, and grazed leniently rather than closely at this stage. If, after such treatment, they are shut up in May or early in June, then in all but the more severe districts they may be expected to provide a substantial amount of feed in the latter part of July and in August.

If at this season dead pasture vegetation provides evidence of infestation by the grass-grub, then, when possible, feeding out of hay, silage, and roots should be concentrated on the infested areas unless these are in fields which are to be put under the plough in the immediate future. The use in this connection of hay saved at too mature a stage of growth may supply considerable numbers of viable seeds of valuable pasture species, and these seeds, on germinating, tend to repair the damage done by the grubs. Further, the additional stock trampling and consolidation of the land which results from feeding-out either lessens the activities of the grubs or assists in the recovery of any injured plants by favouring root renewal.

Apart from the paddocks specially treated for the production of early feed as already discussed, farmers should now proceed as rapidly as possible with any harrowing and top-dressing that remain to be done before the arrival of the dormant season of grassland. Manures applied when the soil is so cold that grass-growth has practically ceased have little or no effect until greater soil warmth returns. Just when it is too cold to apply manures effectively is controlled largely by geographical position, though such circumstances as drainage and aspect affect the matter; in the coastal districts fertilizers as a rule may be applied with good effect later than in cooler inland situations, and later generally in the North Island than in the South Island. Although top-dressing should be carried out before the advent of the most inactive period of growth if this is at all possible, it sometimes may be advisable to top-dress during the "dead" period of pastures as an alternative to the inconvenience and, possibly, inefficiency arising from a heavy rush of work in the spring. Phosphatic manures applied in the dormant period as a rule exert their influence as soon as the warmth necessary for growth returns; it is considered that normally their effect is merely delayed and not lost—wide observations in the field support this view. The same position is believed to hold in general relative to both lime and potash. But it is radically different with soluble nitrogenous manures such as sulphate of ammonia: if conditions unfavourable for growth prevail for any considerable period after the application of such manures, their influence, judging from fairly extensive field experience, is considerably lessened.

Phosphates hold the key position in New Zealand top-dressing: the first and principal necessity is generally the application of phosphates, and so phosphates as a rule may be expected to give the greatest and most immediate profits. There are exceptions to this rule, but a farmer should make sure his case really is an exception before ignoring the rule in his practice. An exception may be expected when, on all but the richest soils, a visible benefit from phosphates is not evident: trial applications of both lime and potash are highly advisable when distinctly visible results

from phosphates are not obtained on soils of medium to poor quality in districts with an average rainfall of 25 in. to 30 in. or more. Incidentally, whether distinctly visible results are also profitable results is dependent largely upon the composition of the sward : a distinctly visible benefit in a pasture composed mainly of weeds and inferior pasture-plants may also be a distinctly unprofitable result, but, nevertheless, it may be of value as an indication of potential profit from top-dressing to be realized when the composition of the sward is suitably improved.

### Crop Utilization.

Generally it is highly inadvisable to allow "wet" and growing young stock to fall off much in condition before a commencement is made with the feeding of reserves of such materials as hay, roots, and silage.

The winter feeding of stock on roots alone is undesirable. Stock so fed receive a diet which is much too watery and cold, and which is likely to lead to digestive disorders. Heavy root feeding is especially unsuitable for old toothless ewes if the roots are offered intact, while to any class of breeding-ewes and to dairy cattle it is inadvisable. To secure the best results from roots they should be fed with some dry feed such as hay or chaff.

Misconception about the feeding-value of silage seems to be common. The misconception generally arises from attributing a nutritive value to silage greater than actually characterizes it, with the result that stock which are considered to be fed adequately are really being semi-starved. The true position may be deduced from the fact that the ensiling process is merely preservative in its effect, and does not lead to an improvement in the nutritive value of the material being ensiled—in fact, it leads to a falling-off in nutritive value. Guidance on the feeding of silage is to be found in the following facts : 1 lb. of typical grass silage equals in feeding-value approximately 2 lb. roots ; 1 lb. of good average hay is equal in feeding-value to 2 lb. to 2½ lb. of grass silage ; 1 lb. of silage is of somewhat lower feeding-value than 1 lb. of the green herbage from which the silage is made. It is inadvisable as a rule to feed animals on silage alone : silage should be used to supplement pasture just as hay and roots ordinarily are used for that purpose. Under New Zealand conditions it should seldom be necessary to feed to dairy cows more than 40 lb. each daily : usually smaller amounts suffice in conjunction with the feed provided by the pastures. As a supplement to pastures silage has been fed with profitable results to sheep at the rate of about 2 lb. a head daily. Silage as ordinarily made in New Zealand is far too fibrous or stemmy for satisfactory results from feeding to pigs, which differ physiologically from sheep and cattle in a way which necessitates less fibre in the feed of pigs if good results are to be assured.

In many cases the pulling and storing of mangels should be done in June, especially if the land occupied by the mangel is required for another crop such as oats, which should be sown soon, or if the land is likely to become so wet later as to make handling of the crop difficult. But general rules about the time of pulling mangels tend to be unreliable : the position varies somewhat in different districts and seasons. Crops may continue to grow in weight well beyond the date fixed arbitrarily by some as that at which pulling should be carried out. It is doubtful whether it is generally advisable to pull such crops early in June if they are not to be used until late August or September. However, if the crop is to be fed to stock earlier than the time mentioned, then it should be pulled in good time to allow it to ripen or mature before it is eaten by the stock. Freshly pulled mangels are more subject to frost injury than those still in the ground or those that have been pulled for a few days. Hence, in order to avoid frost injury, an endeavour should be made to select a period of broken mild weather for the task of pulling. Many sheep-farmers successfully utilize mangels without

storing them. Customarily, after the leaves have been eaten off by broken-mouthed sheep the roots are harrowed out in breaks some days before other sheep are given access to them. This takes place usually somewhat late in the season, when the mangels before being dislodged have already undergone a considerable amount of natural ripening.

### General Work with Arable Crops.

When the soil is not distinctly wet and cold, oats and barley may sometimes be sown with success in June to provide valuable spring feed. Such crops should not be drilled deeply, and usually respond profitably to a dressing of about 1 cwt. an acre of superphosphate. Seed treatment for the control of certain common diseases should not be omitted.

Heavier yields than those commonly obtained of mangels, chou moellier, rape, and potatoes generally would be more profitable after making due allowance for the extra expenditure or effort needed to secure the heavier yields. This is due to the fact that as a rule the main heavy items of cost have to be met whether the crop is merely a medium one or a really heavy one. For instance, the costs of land, of seed, of some manure, of ploughing, harrowing, disking, drilling are the same for a 30-ton crop as for a 60-ton-an-acre crop of mangels.

One of the main factors limiting crop-yields is insufficient tillage especially before, but also after, the sowing of the seed. Under many circumstances it would be advantageous to begin at this season the preparatory cultivation for the crops already mentioned. When land carrying old pasture is to be used for such crops usually the first steps should be skim-ploughing, followed by disking to pulverize the soil, which later should be turned down deeply by a full ploughing, and then left undisturbed by the subsequent surface tillage needed to get a fine seed-bed. The original surface layer of an old pasture is likely to be heavily infested with weeds and weed-seeds, and in order to place this layer well underground where they will give the minimum of trouble it is sometimes of value to use on the plough a suitable skimmer-attachment which facilitates the complete burying of the surface layer and thereby lessens the development of weeds between the furrows.

### Drainage.

Much poorly drained land in New Zealand would give profitable returns immediately from expenditure on suitable drainage. Especially in arable farming, drainage of isolated relatively small wet areas often is a most profitable improvement which does not call for considerable outlay. When tile drains are used in the drainage of isolated wet spots the lines of drains should be located so that they would serve of part, and possibly as the basis, of any more comprehensive future work.

Money may easily be wasted on drainage, even in the case of land very poorly drained, unless the work is properly planned and carefully carried out. Considerable information about practical aspects of drainage is available from district officers of the Fields Division of the Department of Agriculture.

Occasionally drainage is not practicable; then the employment of useful plants which tolerate poorly drained conditions should be considered. Fortunately there is available a fairly wide range of such plants which vary substantially in the degree of wetness which they will tolerate. *Glyceria fluitans*, *Poa aquatica*, and strawberry clover, for instance, prove useful on land which may be immersed for prolonged periods each year, while meadow foxtail, *Poa trivialis*, and *Lotus major*, though not suitable for such land, are useful for land which is far too poorly drained to provide a satisfactory habitat for rye-grass, white clover, or cocksfoot.

### Ensilage Work.

Pits and trenches are economical for ensilage—firstly, because they lessen the wastage of material in comparison with the stack system of ensilage, and, secondly, because they make the work less laborious. Further, satisfactory pits and trenches can be provided at very little cost, and while many farms may not have suitable sites for pits, the farms on which there are not suitable sites for trenches are not at all numerous. The provision of suitable pits and trenches often conveniently may be given attention during the relatively slack winter period. It is a distinct disadvantage to have only one pit or trench on a farm in that it necessitates either the transport of the heavy green material considerable distances at times or the saving of silage from certain handy fields so frequently that deterioration of their swards cannot but take place. As a means of avoiding the need of choosing between these undesirable alternatives some progressive farmers provide a number of pits or trenches not all of which are used every year. This excellent practice has the additional advantage of facilitating the creation of greater reserves of feed than the customary ones which are inadequate provision for any prolonged period of low production of feed such as occurs when an unfavourable summer follows a severe winter.

*—R. P. Connell, Fields Division, Palmerston North.*

---

## THE ORCHARD.

### Cultivation.

PLOUGHING, if not already commenced, should be put in hand at once so that the soil may be turned over and exposed to the beneficial action of the winter rains and frost. It is advisable to plough to the trees, leaving an open furrow along the centre of the lands between the rows of trees so that any water collecting in the open furrows may be as far away as possible from the main roots of the trees. Always plough with the fall of the land to assist in the drainage of surplus water.

### Manures and Fertilizers.

Where required, carbonate of lime may be applied to the soil at the rate of 1 ton per acre, after the ploughing is finished. During the winter months manures such as superphosphate at the rate of 3 cwt. per acre and muriate of potash 3 cwt. per acre should be applied just prior to this the deepest ploughing of the year, where such fertilizers are required, as they are not readily washed out of the soil, and will be available to the tree-roots in the spring.

Cover-crops, in suitable districts, should be just coming into flower, which is the correct time to turn them under, as before this stage of their growth the legumes have not sufficient nitrogen for the trees to derive the maximum amount of benefit.

### Pruning.

No trees call for more skilful treatment than do the peach and nectarine, owing to the need for maintaining a supply of fresh wood and spurs on lateral growth. The peach and nectarine bear only on the past season's wood-growth, and care must always be given to the proper feeding and cultivation, so as to ensure adequate growth.

These trees come into bearing at a very early age, frequently in the third year after planting. It is wise to form a low, stocky tree, with a strong, open framework to carry the crop, obtaining a wide, open base, and an open head with plenty of space in the centre and between each of the leaders.

Some pruners practise far too open a system of pruning. This should not be overdone, for it leads to sun-scald and consequent checking of the sap-flow. Once the full number of leaders has been obtained, the leaders

should be maintained intact, without branching, in the same manner as obtains with the apple and all other deciduous trees. The leaders should be pruned in such a manner as will maintain their position in the tree, otherwise the buds on the terminal growth develop into fruit-buds, and the lower fruit-bearing wood starve and ultimately die. By pruning hard and feeding well the tree can be kept in good bearing from base to top for twenty or more years. By hard pruning and by keeping the tree reasonably open (for it must be remembered that peaches and nectarines are heavy-foliaged trees and will not stand crowding) the fruiting-laterals along the main and sub-arms can be kept healthy and productive, by a constant renewal of growth, but if light and air are shut out by overcrowding of the top, the lower fruiting-wood soon becomes exhausted and starved, and bare, barren limbs are the result.

The points of the leaders should be cleared of competing shoots, but the small lateral growth of the past season immediately below the tips should not be removed. This has the effect of checking the sap-flow slightly, causes the buds below to throw out fruiting-laterals, and in this manner the buds are developed farther back on the leaders, the tree is well furnished throughout with laterals, and no extended portions of bare wood result, such as is often seen on peaches and nectarines.

In pruning for fruit, short, woolly-budded laterals may be left unpruned where not too crowded. Weak spurs should be shortened back to the two wood-buds near the base. Where there is too much fruiting and weak wood it is necessary to remove some of it altogether, but always bear in mind that fruiting-wood will be required for next season, as the peach and nectarine bear only on the past season's growth.

Some of the spurs die each year, and others become exhausted or too long, and these must be replaced, or long bare limbs result. It is a good plan to always leave fruit-buds in excess of requirements, because less than one-half of the flowers set fruit. The best fruit-laterals are on the strong shoots carrying a series of two flower-buds with a wood-bud in between. These should be shortened back so as to leave only four to eight of these cluster fruiting-buds according to the carrying-capacity of the tree.

The early varieties of peaches have the habit of dropping their flower-buds just as the sap rises. This occurrence is very prevalent in some portions of the Dominion. It can be overcome only by intense cultivation. The nipping of the latest shoots during the summer, or pruning them immediately the fruit is harvested, is advised. This would have the effect of strengthening the buds. The alternative is to leave the pruning until the "pink" stage of the blossom, for the buds which remain up to that stage do not fall, and there is no risk of cutting off the fruit when pruning. Then shorten back those laterals which show an excess of blossom, leaving others entirely alone and shortening others to wood-buds: in order to "throw" fruiting-wood to carry the following season's crop, constant renewal of growth must be maintained.

The apricot should be pruned with a short main stem, 12 in. to 15 in. high, and very sturdy, wide main and secondary arms. Owing to its brittle nature apricot wood is very liable to split. Narrow forks should therefore be avoided, and also because they are more liable than wide forks are to gumming. The main arms should be well spaced, and started as for other classes of trees. If well cared for the tree is a strong, wild grower, and for the first four years it should be both summer- and winter-pruned—pruning the leaders and thinning them as well as the lateral growth. The early summer treatment is advisable only when the trees are strong and vigorous, but the lateral growth may be treated during every summer up to the fourth or fifth year. Summer pruning should not as a rule be practised after the tree has settled into good bearing habits and the wood-growth has steadied.

Summer-pruning hastens the building-up of the tree, as well as helping to form a sturdy, strong tree, and to check the natural tendency of the apricot when young to grow wild and rampant.

Both the summer and the winter prunings should be fairly hard for the first three or four years, after which the leaders should be left longer. The tree is naturally prolific and early in its bearing, if planted in suitable soil and situation, and, well cared for, will bear a good crop in its fourth year. It throws out short laterals, which are the fruiting-spurs, all round the main and secondary arms, and light and air circulation are well provided by the wide system of pruning which ensures the full ripening and development of the fruiting-wood. By "heading-off" during early summer the required number of leaders are quickly obtained, and it is not then desirable to have any further forks or branching. The summer pruning will develop plenty of fruiting-laterals, but after the discontinuance of summer treatment the leaders should, in the winter pruning, be headed just above the cluster of small lateral growth usually to be found about half-way up the last season's growth. This causes the sap to be checked slightly, resulting in the buds below the cluster throwing out light laterals. With proper attention to this point no bare wood will result along the leaders. As the top growth ceases the pruning should become much more severe, because it is then necessary to prune the leaders hard to encourage top growth, and the clusters referred to are not required for checking the sap-flow. When pruning for fruiting-wood every care must be given to the thinning and shortening-in of the longer laterals to from four to six buds, cutting just beyond fruit-buds and to a wood-bud, otherwise the tree is liable to overbear and produce small unmarketable fruit; and, apart from this, the spurs will be too long. The short laterals are best left alone until after bearing, when they should be cut back gradually, as they begin to branch. "Water-shoots," unless needed to fill a space caused by the breaking or removal of a limb, are best removed flush with the limb; but in the case of old trees not too well clothed with fruiting-wood on the main and secondary arms, the "water-shoots" should be retained and fully utilized by constant cutting or nipping back during the summer, before they get too strong and too long. By this means good fruiting-wood can be produced along bare limbs, to replace that which has been lost. If left alone, "water shoots" will take an undue amount of the sap and rob the rest of the limbs.

Prunes and plums which make strong growth should be both summer- and winter-pruned up to the fourth year, in the same manner as for apricots—that is, both laterals and leaders should be pruned during the summer.

Start the trees, as in other varieties of deciduous fruits, with low stem and open sturdy main and secondary arms and hollow centre, and prune regularly every winter and summer if the growth is strong, obtaining a nice shapely tree. The small growth round the base and up the main arms should not be removed, but should be lightly pruned each season. This shelters the main arms and trunk, and later on the small growth bears fine crops of fruit, which ripens later than the fruit above, and extends the harvesting-period.

Most varieties of cherries are upright growers, and every effort must be made to spread the tree during the first few years and to obtain a sufficient number of leaders. For the first three years prune very judiciously and spread the tree well, obtaining as wide forks as possible, as narrow forks gum badly. Pruning should be carried out in the spring time when the sap is rising (when the buds are commencing to burst), as this assists in the prevention of gumming in cherries.

It is best to obtain as many leaders as are required during the first three or four years, for after this period it is advisable not to prune so severely, but to confine one's attention to removing any cross-limbs or

branches and shortening-in any long laterals. The leaders should, however, be cut back slightly to a single bud, to keep them sufficiently stiff to prevent them from bending down to a harmful degree Leaf-spurs, if not pruned, usually develop into fruit-spurs, which is usually the culmination of another season's activities. Many leaf-spurs are, however, removed with the shortening of old leaf twigs. The acquirement of fruit-spurs should be the aim of the pruner. Consequently, when attained, no pruning is applied to the individual spur until such time as the accumulated extension of many seasons result in an attenuated and gnarled condition being reached, when the sap circulates too sluggishly to induce the development of an ample supply of strong flower-buds. When signs of this condition are detected the spur should be cut back to a subdivision, if present, near to the parent limb. If such is not available, nothing but the complete suppression of the old spur is recommended, when possibly dormant base-buds may be started into activity to replace the old spur.

All big cuts (which should be made in summer only) should be painted over with a bitumen emulsion, or with white or red lead.

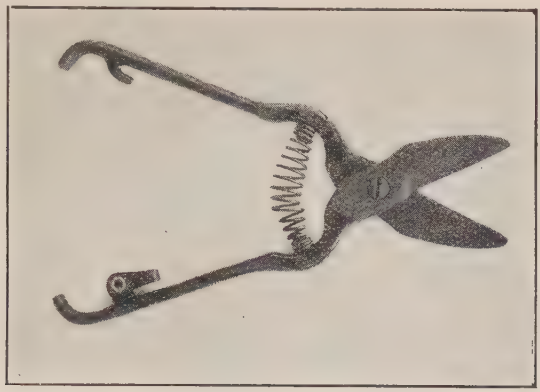
*—B. G. Goodwin, Orchard Instructor, Christchurch.*

### Citrus Culture.

*Harvesting.*—During the coming few months more of the main crop of lemons reach the approved size for picking. By this is meant that they become of sufficient diameter to pack out after curing, counts ranging from 180 to 234 to the standard bushel case. These are the sizes which are preferred by the buyer, and for which he will give the highest price. The 216 count probably is his first choice. As with other kinds of fruit, it is important that the producer of citrus fruit, as far as is practicable, supply the buyer with a product which meets the requirements of the trade. Preferred sizes generally return from 1s. to 1s. 6d. per case more than the larger counts, with even a greater difference against the very small fruits. There are some who hold that it pays the grower to produce the 162 and 150 sizes even at the above-mentioned discount, as more boxes can be filled with the same number of fruit, and that the cost of picking, wrapping, and packing per box is less. In regard to this it should be remembered that lemon-trees are bearing almost continuously, and picking should be kept up to date in order to maintain vigour and growth in the smaller fruit formed more recently. Additionally, most pickers do not secure complete accuracy in picking for size, and there are always some fruit under or over the standard. Hence, if a larger lemon is taken as the standard in picking, a greater percentage will be too large for inclusion in the standard "extra fancy" and "fancy" grades. Then, again, if a buyer is not obtaining his quota of preferred sizes from the usual sources of supply he may be forced to look elsewhere for his supply. There is evidence that the housewife prefers a larger lemon than she is now being supplied with from the stores, but until the method of marketing and distribution is altered it appears to be advisable for growers to pay strict attention to supplying the buyers with the sizes which they require.

Owing to the shrinkage which takes place during curing, lemons have to be picked approximately $\frac{1}{8}$ in. larger in diameter than the size required for a cured lemon. Unless definitely skilled at size-selection, the picker should carry, when at work, one of the light metal size rings which may be obtained from any of the citrus-packing sheds or orchardists' supply organizations. Any lemon which goes through the ring, which is $2\frac{1}{2}$ in. in diameter, is not yet up to size for picking. There is an exception to this rule, and that is in the case of lemons which through some cause, such as lack of vigour in the tree or frost injury, become tree-ripe. Such fruits should be picked forthwith. However, in a well-managed grove

one does not expect to find many of this type of lemon at this time of the year. It is possible also to have lemons which are up to size but which are too immature for picking. These fruits do not colour or cure satisfactorily. They are few in number, however, and one can detect them only after practical experience. Picking is done by means of special clippers, the blades of which are slightly curved and rounded at the "nose."



Two cuts are generally required to pick a lemon, the first severs the fruit from the tree with stalk or twig still attached, and the second cut trims off this stalk level with the button. The leaving of sharp stubs is a very prolific source of damage to fruit by skin-punctures, with subsequent loss by blue and green mould. It is very important that those in charge of picking-gangs spend time in checking this point, the most suitable opportunity for this occurring when pickers are emptying their bags into the orchard boxes. At the same time observation can be made as to the care with which the fruit is placed in the cases. It has been claimed that a fall which breaks an egg injures a lemon or an orange. Orchard boxes should be filled properly, but on no account should fruit project above the sides so that when stacked injury occurs. Investigations reveal that these small points, together with those enumerated in February notes under the heading "Picking," are the causes of mould gaining an entrance to the tissues and the subsequent loss which occurs. The mere fact that each matter appears to be comparatively trivial often causes its neglect, but until sufficient attention is paid to these details by practically every grower the industry must continue to suffer.

The rule of picking according to size irrespective of colour does not apply to New Zealand grapefruit and sweet oranges. For dessert purposes these should be left on until they are tree-ripe, when they should have acquired both flavour and good typical colour. Grapefruit is becoming popular as a breakfast food, and is used in a manner similar to that in which the American type is used overseas. The possibilities of increasing local sales of the New Zealand product are great indeed, but, unfortunately, much of the fruit is still being marketed in too immature a condition. Unless this fruit is tree-ripened it certainly will fail to be more in demand. This would be most unfortunate, and can be avoided if care is taken not to harvest the fruit before it has become palatable. Even for marmalade the specifications of the large jam-manufacturing concerns indicate that they do not desire the green fruit, but prefer the more mature, well-coloured article. No doubt there is a certain domestic demand the meeting of which causes growers to harvest immature fruit against their better judgment. When this cannot be avoided the practice already adopted by some packing sheds of distinctly labelling the cases with an indication that the fruit is for marmalade-making only should be followed.

*Disease Control.*—The principal winter disease of citrus is brown-rot. To prevent infection all parts—fruit, foliage, and wood—should be protected with a covering of Bordeaux 3–4–50, to which has been added summer-oil 1–100 as a wetting-agent. This matter was dealt with last month, but is repeated now, as the danger period extends right through the winter. Growers often assume that because they quite plainly can see traces of Bordeaux on the trees these are sufficiently protected, even although the application was made several weeks previously. According to research workers, the visible deposit after this interval is merely lime, which is generally in excess in all Bordeaux mixtures: the fungicidal value has all been expended. Apart from this, relative to maintaining coverage, the fruit is growing rapidly and making new tissue which has not yet been sprayed, while the same often may be said of the foliage. In some instances growers consider that their autumn application for the prevention of verrucosis serves as a brown-rot spray as well, while others think that the May application for brown-rot is in time to protect the autumn setting of fruit from verrucosis. These growers fail to control one disease or the other or both. When certain diseases, such as verrucosis, do not occur, spray programmes may be modified accordingly.

In some districts leaf-roller caterpillar is in evidence, and, apart from the damage this pest does to foliage, on young trees as well as on old, it also bores into the fruit and causes premature dropping and decay. Where it is known to be present, arsenate or lead powder 1½ lb. to 100 gallons should be added to the Bordeaux mixture. The leaf-roller caterpillar is much more prevalent on oranges than on lemons.

*Grading Standards.*—It appears necessary once more to draw the attention of growers and curing-shed managers to the provisions of the lemon-grading regulations, particularly to section two, which reads as follows:—

"Lemons for inclusion in any grade shall have a minimum juice content of not less than 25 per cent. by volume. For the purposes of this clause the juice content of lemons by volume shall be determined as follows: The fruit volume of a representative sample of not less than twelve lemons shall be measured by water displacement. The quantity of juice contained in the fruit shall then be extracted by reaming or by other approved means; then screened by pressing through cheese-cloth, and its volume measured. The percentage of juice by volume shall be ascertained by dividing the measure of the juice volume by the measure of the fruit juice volume and multiplying the result by 100."

—*A. R. Grainger, Orchard Instructor, Tauranga.*

## POULTRY-KEEPING.

### Census of Poultry, 1936.

THE following is the principal result of the census of poultry which was associated with the census of population taken for 24th March, 1936, as compiled by the Census and Statistics Department, and published in the *Monthly Abstract of Statistics*, February, 1937. The figures relate to both male and female birds:—

| | North Island. | South Island. | Total. |
|---|---|---|---|
| Fowls .. .. .. | 1,939,581 | 1,548,935 | 3,488,516 |
| Ducks .. .. .. | 271,187 | 106,604 | 377,791 |
| Geese .. .. .. | 36,550 | 30,117 | 66,667 |
| Turkeys .. .. .. | 68,740 | 17,362 | 86,102 |
| Total poultry .. .. | 2,316,058 | 1,703,018 | 4,019,076 |

The proportion of poultry to population is higher in the South Island than in the North Island by about one-third. The above figures include poultry maintained by Maori households, amounting to 107,361 birds, in 7,256 flocks. This is believed to be the first occasion on which data regarding Maori poultry flocks have ever been compiled. The smallness of the figures now disclosed shows that the omission of past years was unimportant. Per head of Maori population aggregate Maori flocks give an average of only 1·3 birds: a similar figure for the European community gives 2·6 birds.

Movement in the numbers of poultry over the last six censuses has been—

| Census. | Fowls. | Ducks. | Geese. | Turkeys. | Total Poultry. |
|---|---|---|---|---|---|
| 1906 .. .. .. | 2,784,269 | 281,999 | 44,300 | 77,101 | 3,187,669 |
| 1911 .. .. .. | 3,215,031 | 329,230 | 45,389 | 97,933 | 3,687,583 |
| 1916* .. .. .. | 3,141,354 | 220,808 | 46,955 | 56,521 | 3,465,638 |
| 1921 .. .. .. | 3,491,567 | 379,988 | 46,234 | 73,220 | 3,991,009 |
| 1926 .. .. .. | 3,308,384 | 352,030 | 43,879 | 76,852 | 3,781,145 |
| 1936 (excluding Maori flocks) | 3,415,793 | 351,608 | 61,418 | 82,896 | 3,911,715 |
| 1936 (including Maori flocks) | 3,488,516 | 377,791 | 66,667 | 86,102 | 4,019,076 |

* Census taken in spring; all other censuses in autumn.

The ten years, 1926–36, increase in the poultry totals was only 130,570, or 3·5 per cent. of the 1926 level. Since 1911 the numbers of poultry have not kept pace with the growth of population. The average number of birds per head of population has been as follows. Maori flocks are not included:—

| | | | |
|---|---|---|---|
| 1906 .. .. .. | 3·6 | 1921 .. .. .. | 3·3 |
| 1911 .. .. .. | 3·7 | 1926 .. .. .. | 2·8 |
| 1916 (spring) .. .. | 3·2 | 1936 .. .. .. | 2·6 |

The number of households maintaining poultry numbered 166,354, or 159,098 if Maori households be omitted. This gives an increase of only 242 on the 1926 figure of 158,856, and therefore represents a very distinct fall in the proportion of poultry-keeping households to total households. For this a number of reasons at once suggest themselves. In rural districts there were 99,766 flocks aggregating 2,917,039 birds. In cities, boroughs, and town districts there were 66,588 flocks containing 1,102,037 birds. There has been a definite decline in poultry—both in flocks and in number of birds — kept in urban districts. Apart from other influences, the filling-up of towns and the tendency towards flats and apartments would preclude to many the keeping of poultry.

Omitting geese and turkeys, and dealing with fowls and ducks only, the size of the average flock is some 23·3 birds. The great majority of flocks are small, 81 per cent. of the total containing fewer than 25 birds, and it is clear that the bulk of New Zealand's poultry is to be found not in the large flocks of the poultry-farmer, but in the small flocks which the rural or urban householder maintains as an incidental to his other pursuits. Flocks of fowls or ducks were as follows:—

| Birds. | Flocks. | Birds. | Flocks. |
|---|---|---|---|
| 1– 11 .. .. | 65,669 | 300–399 .. .. | 258 |
| 12– 24 .. .. | 68,479 | 400–499 .. .. | 167 |
| 25– 49 .. .. | 21,286 | 500–749 .. .. | 202 |
| 50– 74 .. .. | 5,266 | 750–999 .. .. | 108 |
| 75– 99 .. .. | 2,030 | 1,000 or over .. .. | 194 |
| 100–149 .. .. | 1,179 | | |
| 150–199 .. .. | 565 | Total .. .. | 165,949 |
| 200–299 .. .. | 546 | | |

While the above figures show a fall in the proportion of poultry-keeping householders to total householders, the returns also show that there were 504 flocks of 500 birds and over, as compared with 214 flocks of 500 birds and over in 1926, which would indicate that a larger number of poultry-keepers are specializing in the business and depending upon poultry as a means of a good deal of their livelihood.

### Introducing Fresh Blood.

Where it is intended to purchase eggs for incubation, day-old chicks, or young pullets during the season it is advisable to place orders early, for by so doing breeders can make arrangements accordingly, and intending purchasers are not likely to be disappointed.

There are many strains of stock of high production to select from, and it is not difficult to breed for high egg-production, but it is always a difficult matter to keep on breeding for great egg-production and retain that vigour and constitution which are so essential.

Good egg-production is of course necessary, but if breeding-stock are continually selected for egg-production alone there is a tendency for the individual birds of a flock to become too small, and offspring from such parents are more likely to be constitutionally affected and difficult to rear. Body size and weight should be maintained, and it is advisable to watch this point when selecting fresh blood. If fresh cockerels are to be purchased for the coming breeding-season no time should be lost in placing orders, for if this is left till just near mating-time one is not likely to get the best selection. Those requiring fresh cockerels for next breeding-season may, if they so wish, purchase three different blood lines from this Department's Wallaceville Poultry Station. White Leghorn cockerels of pure Wallaceville blood, pure New South Wales blood, and half Wallaceville and New South Wales blood are for sale at from 20s. to 40s. each, according to quality. Full particulars may be had from the Poultry Overseer, Wallaceville.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

---

## THE APIARY.

### Winter Precautions.

Before the cold weather sets in every hive should be examined in order to make sure that the frames are completely covered with sufficient dry, well-fitting mats to keep the bees protected. Wherever a damp or mouldy mat is discovered it should be replaced with a dry one, and the roof examined and repaired. No draughts should be allowed around the frames. Mats made of corn-sacks cut to the exact size of a zinc queen-excluder answer all requirements of warmth. They should be placed in their exact position. If placed crookedly the edges are apt to be pushed out between the hive-body and the roof, and if so, in time the mats absorb enough moisture to make them damp and unwholesome.

Once more the time approaches when the necessity for shelter should impress itself on the beekeeper. It is most essential that the bees be protected from cold winds during the winter. Should no permanent shelter be available, something temporary should be erected if the bees are expected to prove in normal condition in the spring. Manuka scrub is excellent for making a temporary wind-break.

Weeds and grass should be kept down. A good clearing round the hives in autumn suffices until spring, and adds materially to the comfort of the bees and the well-being of the hives. Not only should the entrances be cleared, but the ground all round the hives should be similarly treated, and the weeds raked up and destroyed.

### Care of Hives.

At no other season is the welfare of the hives of such importance as during the next few months. Every hive should be raised from the ground to the height of one brick, and if the situation is damp or low-lying it is a good plan to raise the hives still more. This tends to keep them free from slaters (wood-lice) and other insects, and affords less harbour for mice. Further, it ensures that the hives have a free current of air beneath the bottom-boards and are thus more likely to keep dry. If the bottom-boards rest on the ground they rot in a very short time and become mouldy and evil-smelling.

Before bad weather sets in it is a good plan to give a coat of paint wherever it is needed, at the same time stopping up all cracks in the supers. Cracks afford ventilation during the summer months, but they hardly are to be advocated on that account, because the beekeeper usually finds that towards the end of the honey-flow the bees use much valuable time in gathering propolis to paste up the cracks in view of the approach of winter. The hives should be slightly canted forward, so that any rain which falls on them drains off the alighting-board.

Apart from disease, there is no worse feature in an apiary than the presence of leaky hive-covers. A roof which allows moisture to trickle through is a constant menace to the colony it appears to shelter. Not only will the mats immediately beneath it become sodden and mouldy, but the cluster of bees in the hive stands in danger of extermination when frost sets in. There will then be pollution unspeakable on the bottom-board, where the intruding moisture mixing with dead bees and waste pollen forms a fermenting mass, with a stench which the order-loving bees must find more obnoxious than does their owner. There is no excuse for leaky covers. In the autumn the apiarist should examine the covers for any doubtful spots, and should either cover them with zinc, ruberoid, or some other water-proof material. If economy must be practised he may cover with cheesecloth, applying to the roof first a coat of paint, then the cheesecloth, and then another coat of paint. This makes an effective water-proofing, and one which anybody can apply.

### Plans for Next Season.

The "off" season is the best time to make plans for the following season. The beekeeper should decide what increase he desires to make, and should prepare accordingly. Making up hives and frames is exasperating work if left till the bees are crying out for room, and it should be finished long before the actual time for increasing one's stock arrives. The beekeeper should also face the question of providing himself with stocks of foundation, and make arrangements for the treatment of his surplus wax by some neighbouring maker of foundation. He should also decide on which market to place his crop, and lay his plans accordingly. It is advisable, too, that he consider the theoretical side of his occupation, and, while the bees are in a dormant condition, study the best methods of improving his stocks. Neither weather conditions, locality, nor any other factor influences the honey crop so much as strong colonies of bees, and the apiarist should endeavour, while he has the time, to ensure that these shall be in existence during the coming summer.

*—E. A. Earp, Senior Apiary Instructor, Wellington.*

---

## HORTICULTURE.

### Vegetable Crops.

As the present time is a critical period for produce in storage, it should be examined carefully at intervals. Well-grown produce of suitable varieties thoroughly cured and under the best storage conditions usually may be carried profitably for the maximum period. There are, however, circumstances beyond the control of the most experienced growers which may

act adversely on the condition of a crop, as, for instance, the high rainfall which has been experienced in many districts during the past season. The keeping-quality has then to be carefully estimated to enable one to hold the produce as long as possible or ship it to a distant market satisfactorily. In addition to noting the behaviour of minor diseases which may be present, the temperature and humidity of the atmosphere of the store should be carefully adjusted by ventilation. During the early stages of the storage period respiration and transpiration are most active, and gases and moisture are given off in considerable quantities by produce of all kinds. These should be got rid of to a great extent by means of ventilation at suitable periods and by circulating the air in the store, thus checking the bacterial action which may cause decay. The optimum conditions are more readily maintained where the produce is stacked in an open manner to permit circulation of the air. Large stacks tightly packed are most difficult to hold satisfactorily.

The new crop of vegetable-seeds is now available, and consideration should be given to the requirements of the coming season. There is often little to distinguish good seed from bad seed. This naturally makes buying difficult, as there is no means of ascertaining the strain before purchasing. Vitality may be known by germinating a counted quantity; and the impurity of a sample may be to some extent defined by examination.

In no other transaction probably is the buyer at such a disadvantage and so dependent upon the integrity of the seller as in buying seeds. Under such circumstances one buys seed for commercial cropping only from those who have the necessary experience and reliability; neither does one quibble about the price. As a rule cheap seeds have to be stocked for those who cannot resist driving a bargain, but such are generally useless to a commercial grower. To plant out an acre or so of cabbage that does not "heart" or of cauliflower that does not "head" up is something more than a disappointment. Seeds, therefore, of the best strain should be obtained, because they contain qualities for which no cultural skill or attention can be substituted.

On the farm these seeds are often kept in tins or bottles to protect them from the attack of vermin, and in the more humid localities this is perhaps quite the best place for them so long as the conditions are dry. Seeds retain their vitality longest when they are mature, well cured, and stored in a dry place. Humid conditions are most detrimental, especially when the temperature is high. Where storage conditions are good, seeds may be tested for strain the first season, and, if approved, may be sown for a field crop the following season, thus avoiding the risk of serious loss.

Similar precautions are quite as necessary when purchasing potato "seed." Mixed varieties and many diseases may be present and not discernible until growth commences. So serious has been the loss from crops grown from potato-seed containing rogues and tubers infected with virus disease that a system of Government certification has been instituted. To obtain a certificate the seed is grown under close inspection by an authorized person, and a certificate is granted only if the crop proves to be up to the strict specification laid down as regarding purity, disease, and cropping-capacity. Undoubtedly commercial cropping—or any other—should be done only with potato-seed of this class, and this especially in the warmer localities, where virus diseases are always most prevalent. Potato-seed should be obtained as soon as it is available to make sure it receives suitable storage conditions. The early varieties especially are best sprouted in trays for a month or so before sowing, the trays being stacked in a light but not sunny position.

Next to good seed, successful cropping of this kind depends on the suitable preparation of the land. This requires a great deal of consideration where the cropping is intensive if it is to be both economical and efficient.

The chemical, biological, and mechanical condition of the soil have all to receive constant attention. The first has special reference to the supply of plant-foods; the second to the position as regards insect pests, fungous diseases, and weeds present in the soil; the third as regards to the friability of the soil and drainage. For planting out comparatively permanent herbaceous crops such as rhubarb and asparagus the land should be clean, rich in humus, and deeply worked, as only superficial cultivation and manuring can be done after establishment. In any case, heavy land is retentive, slow in coming into condition, and therefore requires early preparation. It clods badly if worked when wet or when nitrate of soda is used consistently. Sulphate of ammonia is a more suitable form of soluble nitrogen, and applications of lime must be made from time to time. On the other hand, a light soil is "hungry" and easily brought into condition. It is best prepared late, using organic manures freely. Owing to rapid assimilation and leaching, artificial fertilizers should be used in comparatively small quantities at frequent intervals. Nitrate of soda is a suitable stimulant for forcing growth, but its extensive use on such land should be balanced by the inclusion of sulphate of potash.

The preparation of land of any class should be carried out sufficiently early to allow it to settle for a fortnight or so before planting and especially before sowing fine seeds. Weed-seeds near the surface will then sprout, and may be destroyed by shallow hoeing during a fine day, after which the crop may be sown under best conditions.

Manure and compost heaps should be turned two or three times at intervals in order to obtain uniform decomposition and to mix the ingredients thoroughly before use.

Wet days provide opportunities for cleaning, repairing, and adjusting apparatus and implements. It is specially necessary where labour is employed to see that all tools, implements, and machines are put away, in clean condition after use, in their allotted position: they then give efficient service over a maximum period, and time and opportunities are not wasted when there is work to be done. Spray-pumps, tractors, seed and manure drills, &c., are now used extensively, and necessary repairs should be done now in preparation for the busy spring season.

### Small and Sundry Fruits.

Established plantations of bush fruits will now require pruning, manuring, and cultivation. These plants generally will remain in profitable condition for eight or ten years, sometimes longer, depending on the quality of the land and the treatment given them, also on the diseases present. Where the plantations are old and infested with disease and pests, they should be pulled, piled, and burnt, and a new plantation set out on fresh ground.

Black currants, gooseberries, raspberries, and other kinds which carry the crop on young wood should now have the old wood cut out unless it has already been done; also superfluous young wood removed where it is weak or crowded. This leaves a good selection of young wood for cropping next season, and encourages the growth of a crop of young wood to follow on. This also opens up the bushes to the air and light, which are so necessary for the production of good blossom and fruit. A common mistake is that they are not opened out sufficiently. The raspberries only require to have the young wood shortened back; this should be done so as to remove the unripened growth and leave only firm, well-ripened wood.

Red currants and others which carry the fruit on spurs on old wood should have all suckers removed completely, and lateral and leading growth shortened back. As leaders become exhausted with cropping they should be removed and new growth trained in, as opportunity offers, to replace them.

Great care is necessary when cultivating these crops, as their fibrous roots are produced near the surface of the ground. At this season a green crop or a dressing of well-cured farm manure may be ploughed in with advantage, so long as the plough is set not deeper than 6 in. On shallow soils, or where cultivation to that depth has not previously been done, the depth of the cultivation should not exceed what has been customary. The addition of a good dressing of bone-dust and sulphate of potash will generally be beneficial, especially on the lighter lands. Most of these crops require more potash than they receive, and it is generally best given in the form of sulphate of potash. A dressing of nitrogenous fertilizer may be given in spring as required, but it should be remembered that an over-vigorous growth is not always the most fruitful.

Preparations for the glasshouse tomato crops will now be under way. The most important requirements for successful cropping are sturdy plants of a good strain, a thoroughly clean house in good repair, and a well-prepared soil. Good plants are obtained by growing them steadily and avoiding the temptation to force the growth by means of high temperatures and a humid atmosphere. There should be no doubt about the house being thoroughly free from the infection of plant-diseases. Serious attacks are generally due to neglect, in some respects, regarding the proper disinfection of the house when clearing out last season's crop. Where the same crop is grown for many years in succession in the same ground, the diseases peculiar to it have a natural tendency to become firmly established unless special precautions are taken. Preparation of the land for planting out should be commenced in ample time to carry it out properly. A common mistake is to plant out in land that is too dry. As it is not subject to natural winter rains it should be irrigated some weeks before planting, so that both soil and subsoil are thoroughly moist. It will have time to warm up and the surface to dry off sufficiently for planting to be done under the best conditions. Comparatively little further watering will then be required by the crop during the critical period in spring when dealing with low temperatures.

**The Homestead Garden.**

Fallen leaves and waste organic materials should be stacked in a humid locality to decay, and so be converted into humus for manurial purposes.

Repairs to roads and walks should be attended to now. Before applying fresh metal, attention should be given to correcting faults in grading the surface so that storm-water will drain off instead of lodging. Gateways and other places where the traffic is concentrated require special attention. Not only is appearance and comfort greatly enhanced when this is regularly and properly done, but the work about the place is facilitated.

*—W. C. Hyde, Horticulturist, Wellington.*

DEPARTMENT OF AGRICULTURE.

**WALLACEVILLE POULTRY STATION.**

**FOR SALE.**

WHITE LEGHORN (NEW BLOOD) COCKERELS, HENS, AND PULLETS.

Also now booking orders for Eggs and Day-old Chicks.

*For full particulars apply*

THE POULTRY OVERSEER, VETERINARY LABORATORY,
PRIVATE BAG TO WALLACEVILLE,
WELLINGTON.

# WEATHER RECORDS: APRIL, 1937.

Dominion Meteorological Office.

## NOTES FOR APRIL.

THE first half of April was warm, and, except in the northern portion of the North Island, dry. Since there was, in most parts, comparatively little wind, conditions were very pleasant. Vegetation flourished and stock were doing well. The second half, however, was very cold for the time of year, and, although not in general heavy, rain was frequent. The ground became cold and saturated, and growth, to a large extent, ceased. There is more snow on the ranges than usual at this time of year.

*Rainfall* was above average in North Auckland, at Tauranga, near East Cape, in the South Taranaki Bight from Wanganui to Hawera and thence inland, and over most of Otago and Southland. In parts of the last-mentioned area the total was double the normal value. Elsewhere there was generally a considerable defect from the average. Rain was very frequent throughout the month in North Auckland and in the East Cape area, while from the 20th onward it was frequent almost everywhere.

*Temperatures.*—The mean temperature for the month was almost everywhere below normal. The only exceptions occurred at a few places in the Auckland Province, where the departures were, in general, rather small. Over the North Island as a whole the average departure was about 1° F. Over the South Island conditions were definitely colder, and the mean departure was about 2° F. Several frosts occurred and tender plants were cut off at a rather early date in most districts.

*Sunshine.*—There was more bright sunshine than usual over most of the southern half of the North Island and at Blenheim and Timaru, but in most other parts considerably less.

*Pressure and Storm Systems.*—The month began with a series of rather deep westerly depressions crossing the South Island. On the 3rd an anticyclone began to approach from the Tasman Sea. Southerly winds set in and were strong in many places. Some snow fell on the mountains at this time. The anticyclone became intense as it reached New Zealand, and its centre moved to the east coast of the South Island on the night of the 4th. Strong south-easterly winds continued to blow to the northwards, and the vigorous invasion of cold air into low latitudes led to the development of a cyclone in the Norfolk Island region. From the 7th the anticyclone began to move away eastwards. Thereafter, a series of depressions developed over the Tasman Sea and the Dominion, the pressure generally showing a falling tendency until the 17th, when there was a brief rise and southerly winds prevailed. During this period and until the 19th there was no very stormy weather.

On the 20th another spell of westerly weather commenced. Strong westerly winds prevailed, and on the 23rd gale force was reached in many places from Nelson and Marlborough northward. By the 24th the last of the deep westerly depressions had passed. Barometers rose and strong south-westerly winds to gales prevailed until the 26th, when they began to decrease. There was much snow on the ranges from the 22nd to the 25th, and numerous hail and thunder storms occurred. Some flooding was experienced in Otago. On the 23rd a number of small tornadoes were reported from the western side of the North Island, each doing considerable damage over a short and narrow path.

RAINFALLS FOR APRIL, 1937, AT REPRESENTATIVE STATIONS.

| Station. | Total Fall. | Number of Wet Days. | Maximum Fall. | Average April Fall. | Total Rainfall to Date. | Average Rainfall to Date. |
|---|---|---|---|---|---|---|
| | *North Island.* | | | | | |
| | Inches. | | Inches. | Inches. | Inches. | Inches. |
| Kaitaia .. .. | 6·99 | 20 | 2·38 | 4·42 | 21·70 | 14·96 |
| Russell .. .. | 5·05 | 14 | 1·77 | 4·44 | 29·20 | 16·86 |
| Whangarei .. .. | 5·86 | 23 | 0·95 | 4·93 | 24·20 | 17·18 |
| Auckland .. .. | 2·71 | 19 | 0·52 | 3·88 | 11·70 | 13·69 |
| Hamilton .. .. | 3·64 | 15 | 0·95 | 3·85 | 13·64 | 14·09 |
| Rotorua .. .. | 3·16 | 17 | 0·76 | 4·41 | 16·81 | 15·91 |
| Kawhia .. .. | 3·32 | 8 | 0·94 | 4·65 | 12·69 | 14·48 |
| New Plymouth .. | 4·14 | 14 | 1·05 | 4·59 | 21·44 | 16·39 |
| Riversdale, Inglewood .. | 5·32 | 14 | 1·44 | 8·11 | 35·45 | 28·69 |
| Whangamomona .. | 4·09 | 7 | 2·04 | 6·52 | 24·29 | 20·97 |
| Hawera .. .. | 4·32 | 14 | 1·12 | 3·48 | 16·20 | 12·40 |
| Tairua .. .. | 3·76 | 20 | 0·75 | 5·96 | 16·81 | 19·51 |
| Tauranga .. .. | 7·54 | 19 | 1·85 | 4·70 | 20·06 | 16·43 |
| Maraehako Station, Opotiki | 3·56 | 13 | 1·33 | 4·74 | 21·22 | 16·43 |
| Gisborne .. .. | 3·32 | 13 | 0·67 | 4·05 | 12·17 | 14·65 |
| Taupo .. .. | 2·89 | 16 | 0·73 | 3·60 | 11·37 | 12·85 |
| Napier .. .. | 1·03 | 9 | 0·30 | 2·36 | 7·65 | 9·98 |
| Hastings .. .. | 0·68 | 8 | 0·28 | 3·33 | 4·55 | 10·27 |
| Whakarara Station .. | 2·39 | 9 | 0·35 | .. | 11·06 | .. |
| Taihape .. .. | 3·21 | 10 | 1·05 | 2·78 | 11·15 | 10·97 |
| Masterton .. .. | 1·29 | 10 | 0·40 | 3·05 | 10·03 | 11·14 |
| Patea .. .. | 4·03 | 12 | 0·78 | 3·67 | 16·76 | 13·01 |
| Wanganui .. .. | 3·34 | 9 | 1·14 | 3·27 | 13·47 | 10·99 |
| Foxton .. .. | 1·81 | 11 | 1·17 | 2·50 | 8·98 | 8·69 |
| Wellington .. .. | 2·30 | 14 | 0·68 | 3·64 | 11·92 | 12·48 |
| | *South Island.* | | | | | |
| Westport .. .. | 6·34 | 13 | 1·38 | 8·25 | 32·31 | 29·30 |
| Greymouth .. .. | 5·57 | 18 | 0·83 | 8·48 | 41·05 | 32·66 |
| Hokitika .. .. | 8·94 | 18 | 1·40 | 9·46 | 44·88 | 36·29 |
| Ross .. .. | 9·95 | 16 | 1·70 | 12·18 | 52·95 | 44·21 |
| Arthur's Pass .. | 12·45 | 10 | 4·83 | 15·42 | 58·20 | 52·63 |
| Okuru, South Westland | 18·66 | 14 | 4·10 | 14·12 | 59·40 | 50·52 |
| Collingwood .. .. | 6·53 | 14 | 1·57 | 8·15 | 31·54 | 25·81 |
| Nelson .. .. | 2·21 | 15 | 0·48 | 3·10 | 11·92 | 11·55 |
| Spring Creek, Blenheim | 1·04 | 8 | 0·25 | 2·12 | 8·89 | 8·50 |
| Seddon .. .. | 1·08 | 9 | 0·29 | 1·71 | 7·44 | 7·40 |
| Hanmer Springs .. | 1·62 | 11 | 0·54 | 3·37 | 9·58 | 13·84 |
| Highfield, Waiau .. | 2·02 | 7 | 0·86 | 2·60 | 6·33 | 11·02 |
| Gore Bay .. .. | 1·96 | 11 | 0·55 | 2·38 | 8·30 | 9·77 |
| Christchurch .. .. | 1·49 | 11 | 0·44 | 1·75 | 7·74 | 7·48 |
| Timaru .. .. | 1·65 | 11 | 1·20 | 1·57 | 9·54 | 7·91 |
| Lambrook Station, Fairlie | 1·30 | 7 | 0·37 | 1·97 | 8·84 | 8·55 |
| Benmore Station, Clearburn | 2·86 | 12 | 0·82 | 2·40 | 12·94 | 9·20 |
| Oamaru .. .. | 1·63 | 15 | 0·37 | 1·79 | 7·09 | 7·40 |
| Queenstown .. .. | 3·02 | 14 | 0·85 | 3·08 | 12·85 | 10·54 |
| Clyde .. .. | 1·59 | 7 | 0·58 | 1·45 | 7·90 | 5·85 |
| Dunedin .. .. | 5·61 | 19 | 1·32 | 2·77 | 18·99 | 11·79 |
| Wendon .. .. | 5·01 | 15 | 0·81 | 2·71 | 22·37 | 10·91 |
| Balclutha .. .. | 4·25 | 17 | 0·76 | 2·19 | 16·52 | 8·80 |
| Invercargill .. .. | 3·07 | 20 | 0·56 | 4·24 | 18·24 | 15·31 |
| Puysegur Point .. | 7·39 | 25 | 1·60 | 7·67 | 36·83 | 29·00 |
| Half-moon Bay .. | 4·62 | 21 | 0·75 | 5·10 | 24·68 | 19·37 |